AN INVESTIGATION OF THE ROLE OF MICROCOMPUTERS AS INFORMATION RETRIEVAL TOOLS IN THE GREATER PIETERMARITZBURG SCHOOLS' WATER AUDIT PROJECTS

by

HILLAR GBAGIDI KOMLA ADDO

BA (Hons), Social Sciences:

University of Science and Technology, Kumasi, Ghana

Submitted as the dissertation component, (counting for 50%) in partial fulfilment of the requirements for the degree of Masters of Information Studies (MIS) in the Department of Information Studies, University of Natal, 1999.

UNIVERSITY OF NATAL PIETERMARITZBURG

1999

Declaration

I hereby declare that the whole thesis, unless specifically indicated to the contrary in the text, is my own original work and has not been submitted for a degree at any other university.

H. G. K. ADDO

JANUARY 1999

Dedication

I dedicate this thesis to my two boys, Mawuli and Edem.

Acknowledgements

I would like to extend my appreciation to Mrs Thuli Radebe and Mr Athol Leach who advised on, probed and perused this work to make it a success.

I also wish to thank Dr Rob O'Donoghue and Mrs Lynette Masuku van Damme of The KwaZulu-Natal Nature Conservation Service, who encouraged me to pursue this study, despite the odds.

My gratitude goes to Dr Jim Taylor and staff of Share-Net (Umgeni Valley), for their moral support and to Mr Steve Camp of Umgeni Water, for making available valuable information which contributed to the success of this work, and to Umgeni Water for sponsoring the editing of this work.

Finally, my sincere thanks to the teachers and pupils who responded to the questionnaires and to all, particularly my wife, and staff of the Department of Information Studies University of Natal, who stood by me in my efforts to produce this work.

Abstract

In South Africa, government (Mbeki 1996:37) and educators (SAIDE Report 1998:9) have expressed concern over the provision of microcomputers for learners. Their provision to schools would allow their effective use across the curriculum and enhance education. This study investigated the role of microcomputers as information retrieval tools in the 1997 schools' Water Audit projects in the greater Pietermaritzburg area.

The study considered, firstly, a discussion of environmental education with emphasis on water conservation, and secondly the Water Audit projects. An overview of issues relating to microcomputer systems as information retrieval tools in education was presented. A descriptive survey method was employed for the study, with questionnaires as the data collection technique. Thirty out of 40 teachers/school project co-ordinators were sampled, with a 24 (80%) response. Twenty percent of 550 pupils who participated in the projects also responded. Data was presented by the use of tables.

The study revealed an unequal availability of microcomputers among the schools in the departments of education, as they existed prior to 1994, that participated in the projects. Findings also revealed that only a minority of pupils used the microcomputer system for information retrieval during the projects. The use of hard copy sources was significantly high within the departments. A high number of pupils who used the microcomputer found it useful. A higher number that used hard copy sources found them useful. Training of pupils to acquire computer and information skills was inadequate. Major problems encountered during the projects included congestion, lack of computer skills on the part of both teachers and pupils and inadequate training of participants. The study found infrastructural backlogs and logistical problems as hindrances to the delivery of education in South Africa using microcomputers. Non-involvement of media teachers negatively impacted on the results of the projects.

It was recommended that schools without microcomputers liaise with donor agencies to acquire microcomputers, while government initiates policies to address the issue of equity. Educators and media teachers should be given concerted training in computer and information skills, as training underpins the use of microcomputers in an information age school.

Contents

Figure

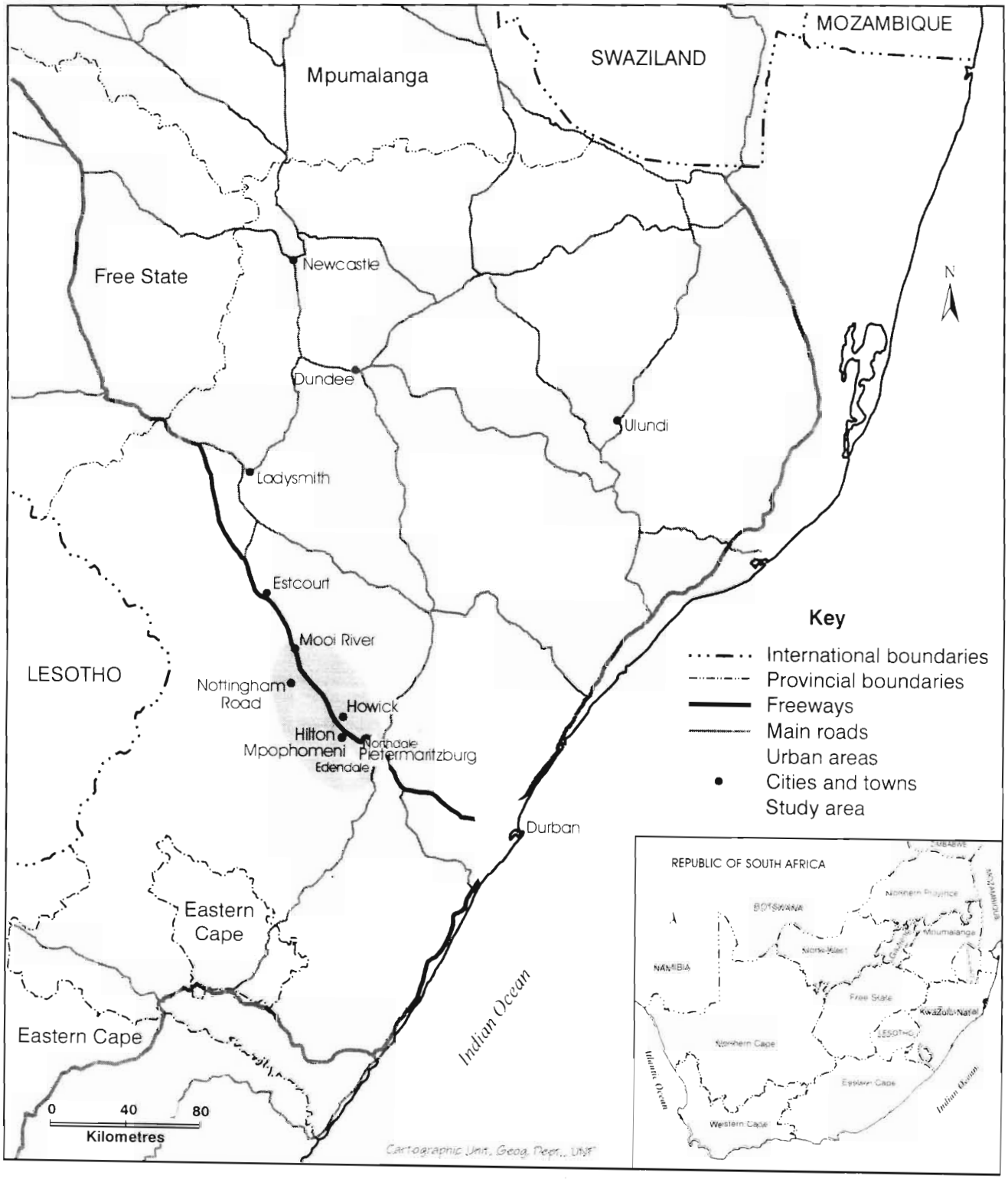
List of Tables

List if Acronyms and Abbreviations

AACR	Anglo American Cataloguing Rules
AASL	American Association of School Librarians
ALA	American Library Association
AECT	Association for Educational Communications and Technology (A USA Body)
ANC	African National Congress
ASCII	American Standard Code for Information Interchange
ASLIB	Association for Information Management (A British Body)
CDROM	Compact Disk Read Only Memory
CPU	Central processing Unit
DET	Department of Education and Training
Dr	Doctor of Philosophy
DWAF	Department of Water Affairs and Forestry
EE	Environmental Education
EEASA	Environmental Education Association of South Africa
EIR	Electronic Information Resources
E-MAIL	Electronic Mail
FTP/ftp	File Transfer Protocol
GREEN	Global Rivers Environmental Education Network
HOD	House of Delegates
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IDRC	International Development Research Centre
ICT	Information and Communication Technology
IT	Information Technology
KNNCS	KwaZulu-Natal Nature Conservation Service
KWIRS	Key Word Information Retrieval System
LIS	Library and Information Science
LIS	Library and Information Services (A USA Body)
mm	Millimetre

NCET	National Council for Educational Technology (A USA Body)
NCHE	National Commission on Higher Education
NPFSLS	National Policy Framework for school Library Standards
NED	Natal Education Department
NEPI	National Education Policy Investigation
NET	Network
NGO	Non-Governmental Organisation
NO	Number
NWCC	National Water Conservation Campaign
PUP	Pupil
RES	Response
SA	South Africa
SAIDE	South African Institute of Distance Education
SIR	Schools Information Retrieval
SNAP	Schools Network Action Project (A USA Body)
TCP/IP	Transmission Control Protocol/Internet Protocol
TE	Technology Education
UCLA	University of California Los Angeles
URL	Universal Resource Locator
USA	United States of America
WWF	World Wide Fund
WWW	World Wide Web
W3	World Wide Web

Map showing area covered by the study



Chapter One
Introduction

1.1 Introduction

The use of microcomputers and related systems in the process of information storage, retrieval and dissemination has increased tremendously throughout the world in recent years, and the field of education is no exception. Herring (1987:i) explained the impact of microcomputers and related systems on education as follows:

> Development of curriculum computer databases has meant closer co-operation between school librarians[1] and teachers; greater use of a wide range of resources in the school library, and an improvement in pupils' ability to plan, organise and present projects and assignments.

With larger information storage capacities of microcomputers and the coming into being of the Internet and the World Wide Web[2] (WWW), easy access to a mass of information has resulted for those who have such access. Kurzweil (1992:80) noted that the day of the virtual book and the electronic journal were not far away, as was predicted by Irving (1988:13) when he indicated that the media centre of the future may be completely portable and electronic.

Herring (1987:13) cautioned, however, that with the availability of microcomputers the technology should not be seen as an end but rather as a means to an end. He argued that the use of the computer as an information resource tool was not being emphasised enough. Karaliotas (1997:8) also noted that technology was a tool and

---

[1]School librarians and media teachers are used interchangeably in this study to mean teachers trained to manage library and information resources, and provide information for curricular use in schools.

[2]According to Gwyneth, Poulter and Hiom (1996:45) the World Wide Web is also known simply as the Web; WWW or W3.

not a driver, as it was designed to serve humanity's interests of play as well as work. Kuhlthau (1994:25) agreed with Behrens (1990:355) that, while the use of computers will enable one to function effectively in an information age, there is equally a need for cognitive skills to evaluate information for its effective use. These cognitive skills according to Kuhlthau (1994:25) include:

> Locating the problem and the topic of information need, locating the information, analysing and interpreting the information, synthesising and organising information, using and evaluating the information in terms of quality, suitability or relevance.

The South African Deputy President, Thabo Mbeki (1996:45), advocating an information community for South Africa, has emphasised that the human resource paradigm of the emerging information community must take into account the broadest range of social, political and economic activities where information and information technology (IT) were used. Training, he noted, must provide a framework sufficiently comprehensive to allow for human development across a wide range. The use of IT had also been observed as critical for the survival of students in an information age. As Johnson (1995:8) pointed out, success in education, employment and civic involvement increasingly demand the ability to use technology to access, process and communicate online information.

The vision of that information community envisaged by the Deputy President was incorporated into a new curriculum for South Africa, *Curriculum 2005,* which re-enforced the use of technology and information (Musker 1997:11). In the absence of policy on provision of computers to schools, however, private sectors, parastatal organisations and non-governmental organisations (NGOs) in South Africa are assisting schools in the provision of microcomputers. Others are providing databases and Internet facilities to ensure access and use of a wide range of information resources. Some of these initiatives are documented in, for example, Compaan (1990), Young (1995), Samancor (1996), and Condon (1997). The World Bank and the International Development Research Centre (IDRC) have also embarked on projects across South Africa to resource historically disadvantaged schools in this regard. Carrol (1998:1) reported that in an effort by the previously advantaged

schools to share information via the Internet, a new initiative called SchoolsNET[3] has embarked on a project to network 28 000 schools in South Africa, focusing on the previously disadvantaged ones[4]. Olën (1989:45) pointed out that the value and use of microcomputers in school media centres, for example, had been exclusive to schools overseas, and although in use in South African media centres for some time now, not much coverage had been given to their activities. Johnson and Eisenberg (1996:12) also noted that, where computers existed in school media centres or computer laboratories, there was little knowledge among the public and even among educators of how technology could and should be used, and the differences that technology could make in education.

1.2 Background to the study

To address an acute water resource problem in South Africa the Department of Water Affairs and Forestry (DWAF) launched a national schools' water education strategy in 1992 aimed at ensuring that all South Africans, especially the youth, become conscious of the need to conserve water by the year 2020. This strategy culminated in the 1997 schools' national Water Audit projects[5], hence the greater Pietermaritzburg Water Audit projects.

In an effort to provide maximum information for environmental education, the Natal Parks Board now known as the KwaZulu-Natal Nature Conservation Service (KNNCS), in conjunction with Share-Net[6] (Umgeni Valley), researchers, and other

---

[3]SchoolsNET SA is an NGO formed to address issues relating to computer network education in South Africa. It has as one of its priority objectives provision of microcomputers to previously disadvantaged schools.

[4]Disadvantaged schools used in this study refer to schools which were historically under- resourced, as indicated in the NEPI Report (1992a and 1992b) among others.

[5]The Water Audit projects represent two projects (water quantity and water quality) These are outlined by the National Research and Development Officer for DWAF in Section 2.4.2 of this Thesis.

[6]Share-Net is an informal collaborative structure located at Howick (Umgeni Valley) aimed at encouraging grass root resource development by teacher groups, local communities and environmental education agencies.

environmental agencies developed simple fact sheets called *Enviro-Facts*[7]. These *Enviro-Facts* were available in hard copy, on diskette and on the Internet. After providing *Enviro-Facts* in hard copy and on diskette to schools in the greater Pietermaritzburg area[8], the KNNCS went a step further to provide, on loan, computer hardware to certain historically disadvantaged schools in Howick and its surrounding suburbs. This was done to enable such schools electronic access to *Enviro-Facts* and other environmental information for environmental education and, in particular, for the 1997 schools' Water Audit projects[9]. Umgeni Water, which supplies water to Pietermaritzburg and the Durban Metropolitan area, was responsible for co-ordinating the Water Audit projects in the Pietermaritzburg schools, while the KNNCS led the co-ordination of the projects in the Natal Midlands.

Almost all previously disadvantaged schools in the greater Pietermaritzburg area had no computers for information retrieval. Most of the ex-Natal Education Department[10] schools, had acquired through their previous education departments, parents and other sources, computer hardware and software for their computer laboratories, which complimented the books in their media centres. It became evident during the course of this study that the independent (private) schools also had computers for retrieving information in both computer laboratories and media centres. A critical objective of the greater Pietermaritzburg schools' 1997 Water Audit projects was that participating schools use microcomputers to access environmental information from diskette and the Internet, and communicate the results of their project findings electronically with other schools via the Internet.

---

[7]Details of *Enviro-Facts* are discussed in Chapter Two.

[8]The greater Pietermaritzburg area comprises Pietermaritzburg and its suburbs of Northdale, Edendale and Hilton, Howick and its suburbs, farming areas of Mpophomeni, Cedara, Norttingham Road, and Mooi-River, its suburbs and surrounding farming locations. The area covered is shown in the map.

[9]Details of the 1997 schools' Water Audit projects are available in Chapter Two of this study.

[10]The ex-Natal Education schools were among the previously exclusive white schools that were better resourced in the ex-Natal province.

1.3 Statement of the problem

The KNNCS, Share-Net and Umgeni Water, as project co-ordinators, had little or no information on the extent of availability of microcomputers in the participating schools during the Water Audit projects. Neither were they aware of the extent to which microcomputers were used and how useful microcomputers were *vis a vis* hard copy sources for information retrieval during the course of the projects. They also had no information on the levels of acquired skills needed by pupils to enable them to access and use environmental information from computers. The project co-ordinators also had little or no idea of the problems encountered in the course of using the microcomputers as information sources during these projects. There was therefore a lack of information regarding the role of microcomputers as information retrieval tools during the Water Audit projects.

1.4 The aim of the study

Given the above problem, the aim of this study was to investigate the role that microcomputers played as information retrieval tools during the 1997 Water Audit projects in participating schools in the greater Pietermaritzburg area.

1.5 Objectives of the study

To achieve the aim of the study, objectives were set as follows:

1. To investigate the extent of availability of microcomputers as information retrieval tools in schools that participated in the Water Audit projects;
2. To investigate the extent of use of microcomputers as information retrieval tools *vis a vis* hard copy sources in schools that owned such sources and schools which had microcomputers loaned to them;

3 To investigate how useful microcomputers were *vis a vis* hard copy sources as information retrieval tools in relation to the Water Audit projects;

4 To establish the extent to which pupils were equipped through training to use microcomputers as information retrieval tools in relation to the Water Audit projects;

5 To examine problems relating to the use of microcomputers as information retrieval tools during the 1997 Water Audit projects.

1.6 Research questions

To meet the objectives set above, the following questions were formulated:

1 What was the extent of availability of microcomputers as information sources in schools that participated in the Water Audit projects?

2 How often were microcomputers used *vis-a vis* hard copy sources for information retrieval during the Water Audit projects?

3 How useful were microcomputers as information sources *vis a vis* hard copy sources in schools that participated in the Water Audit projects?

4 What was the extent of pupils' skills gained through training to enable them to retrieve and use information from microcomputers during the Water Audit projects?

5 What problems hampered the use of microcomputers as information retrieval tools during the Water Audit projects?

1.7 Significance of the study

In the absence of similar studies in South Africa and other developing countries, it is hoped that the findings of this study will influence debate and enable the KNNCS, Share-Net, Umgeni Water and the DWAF to improve upon the use of microcomputers as information retrieval tools for subsequent school environmental

education projects. It will also provide insight for other school projects where microcomputers are in use or where they are being considered for use as sources for information (Carroll 1998:1). This study is also significant as South Africa and the developing world emerge into the information age, where microcomputers are increasingly becoming tools for education, information and communication in schools.

1.8 Definition of key concepts used in the study

Concepts used in this study are defined as follows:

Microcomputer

Microcomputer is derived from the generic word computer.

A computer is an electronic machine which can accept data, store it, manipulate it as instructed in a program, retrieve it and convey the result to a user (Prytherch 1995:156).

Microcomputers, according to Woodcock (1991:227), are computers built around a single chip microprocessor. They are less powerful than minicomputers and main frame computers[11], but have evolved into powerful machines capable of complex tasks.

A (micro)computer system

According to Freedman (1996:169) a (micro)computer system is the complete computer made up of the central processing unit (CPU), memory and related electronics, all the peripheral devices connected to it and its operating system. For the purpose of this study, a (micro)computer system encompasses databases and the Internet. The microcomputer, the computer and the (micro) computer system are

[11]Microcomputers, minicomputers and main frames are discussed in more detail in Chapter Three.

used interchangeably to mean a tool or machine for storing information, manipulating such information, making the information available to users, and facilitating communication via the Internet.

Computer network

A computer network is a system of physically separate computers with telecommunication links allowing resources to be shared by either commercial or informal arrangements (Prytherch 1995:446).

Database

A database is simply a collection of information, factual or bibliographic, numeric or alphabetic, and textual or graphic. In the context of the microcomputer, a database is a collection of information held in one or more files. Each file has a unique name by which it is accessed. Within a file, information is organised in a number of records, rather like the cards in a card index. Each of these records is divided up into a number of fields, each holding one item of information such as name or address, or author or title (Herring 1989:51-52).

Information

Information is defined by Prytherch (1995:319) as organised data which are communicated. A definition more relevant to this study is presented thus: "Information is all data taken in through the five senses, their internalisation, restructuring or use by the individual" (Dervin 1977:16).

Information retrieval

Information retrieval is defined by Woodcock (1991:185) as "the process of finding, organising and displaying information, particularly by electronic means". According to Prytherch (1995:321) "...earlier methods of information retrieval included comprehensive classification and cataloguing and searching databases, but electronic methods have now generally replaced these systems, and modern retrieval depends on searching full-text databases, locating items from bibliographic databases and document supply via a network".

Information skills

Information skills refer to "transferable cognitive skills of analysing, synthesising, critical thinking, evaluation and presentation of information from a number of sources based on sequential instruction and research or project assignments" (Kuhlthau 1987:26).

Computer literacy

According to Woodcock (1991:77) "computer literacy is knowledge and understanding of computers combined with the ability to use them effectively". At the basic level, he noted that computer literacy involved knowing how to turn on a computer, start and stop simple application programs, and save and print information. At higher levels, computer literacy becomes more detailed, involving the ability to manipulate complex applications and, possibly, to program in computer languages. The term computer literacy is used interchangeably with computer skills in this study.

1.9 Limitations of the study

The researcher was not able to cover all 40 schools that participated in the 1997 Water Audit projects for the following reasons:

1. Some of the schools were beyond the reach of the researcher who, as a student, could not travel to and from these rural areas as this study was not covered by any funding.
2. Attempts to retrieve questionnaires from some of the schools were unsuccessful because the schools were engaged in pre-final year external examination preparations.
3. Some of the schools did not return questionnaires, claiming that they had not fully participated in the projects.
4. Certain schools presented to the researcher by the co-ordinators of the projects indicated that they had not been part of the projects.

1.10 Organisation of thesis

Chapter One is an overview of the study, comprising the problem statement and the aim and objectives of the study. The importance of the study is pointed out, the terms used in the study defined and limitations of the study described. Chapter Two provides a background to the study. Areas examined are the importance of environmental education, the National Water Conservation Campaign in South Africa, the National Water Conservation Vision, *Vision 2020*, the National, as well as the greater Pietermaritzburg, Water Week programme, the development of the environmental information database *Enviro-Facts*, and the Microcomputer project embarked upon by the KNNCS in conjunction with Share-Net (Umgeni Valley).

Chapter Three is a review of related literature on microcomputers as information retrieval tools for education with emphasis on databases and the Internet. It also examines the steps, techniques, and other issues relating to information retrieval from microcomputers. The availability of microcomputers as information retrieval tools in South African schools are also examined.

Chapter Four provides a review of the methodology employed for the study. It examines descriptive survey as the method for the study, examines the means of data collection, research population, sampling, and analysis of responses to data collection. Chapter Five embodies data presentation and analysis based on objectives set for the study, as outlined in Chapter One. Findings from the questionnaires of teachers and pupils are presented and explained. Chapter Six embodies discussion of the findings made. Finally, Chapter Seven presents recommendations made and conclusions reached regarding the study.

1.11 Summary

Chapter One was an introduction to the thesis. It provided a general overview, comprising an introduction, the statement of the problem, the aim of the study,

objectives set, research questions, significance of the study, definitions of concepts used, limitations within which the study was conducted and an overview of how the thesis is organised.

Chapter Two
Background to the study

2.1 Introduction

This Chapter provides background information on the Water Audit projects. It begins with a brief focus on the importance of environmental education. The National Water Conservation Campaign (NWCC) in South Africa and its vision for the year 2020 is then reviewed, followed by an examination of the National Water Week programme and the greater Pietermaritzburg area Schools' Water Week projects. The development of the information database *Enviro-Facts* as an information source is discussed. The Chapter ends with a description of the microcomputer project embarked upon by the KwaZulu-Natal Nature Conservation Service (KNNCS), in conjunction with Share-Net (Umgeni Valley).

2.2 The importance of Environmental Education (EE)

Mankind's continued existence is seriously threatened by the way he has thus far treated his environment and the Earth's natural resources. It was not in vain that the Earth Summit held in Argentina in 1992 was convened and highlighted in the literature. See, for example, Our Earth 1992, Brosius 1993 and Holmberg and Timberlake 1993, to mention a few.

Gower (1992:6), noted that problems created by the lack of care for the environment brought about by lack of education were indeed enormous. He noted that "the prices we pay today include: over population, lack of water, fuel and food, overuse of land resulting in deforestation and soil erosion, rising ocean levels, the

green-house-effect and rising temperatures". He pointed out that:

> the effect of the causes listed above include; hunger, malnutrition, disease, disparities between quality of life of populations, pollution, deterioration of the living environment,... thus the shocking environmental devastation is everywhere to be seen (Gower 1992:6).

Briceno and Pitt (1987:219) cautioned that "it stands to reason that if by freewill we cannot better regulate our relationship with our world, it is entirely possible that our world may dispense with us".

Bennett (1989:22), evaluating EE in schools, noted that an important characteristic of such education was its focus on the real world, involving studies of natural and human ecosystems and associated problems. He emphasised that EE took place best in settings such as the classroom, the school site, the community and beyond. Voordouw (1987:93) noted that environmental education could best be learnt through doing things in a group. He emphasised that "In open or group learning systems, society was reflected by the individuals present, shared knowledge and skills, and passing on of experiences and information". In achieving the form of EE envisaged by Voordouw, databases and the Internet could serve as useful information sources and communication media.

Vulliamy (1987:89), however, argued that although group learning was the best form for environmental education, the legacies of colonialism did not favour attempts at curriculum reform which have been more vocalised than vocationalised in developing countries. He cited problems such as inadequate training for teachers, lack of a community education concept, and a formal school system that encouraged the promotion of upward mobility as hindrances to EE. He mentioned that schools were also under-resourced and classroom teaching in developing countries was characterised by formalistic and didactic approaches.

In South Africa the legacy of apartheid has created historically marginalised schools, under-resourced, with poorly trained teachers (NEPI 1992a; National Commission on Higher Education (NCHE) 1996; Radebe 1997). While some schools were

well-equipped with buildings, information resources and well-trained teachers (NEPI 1992a), others lacked these educational resources (Radebe 1997). This has resulted in a condition in worse proportion to what was described above by Vulliamy (1987). Calls have been made (NEPI 1992a; NCHE 1996; Radebe 1997) for redressing the imbalances and the issue of inequity created by the past. Institutions such as the KNNCS and Share-Net (Umgeni Valley) are answering these calls.

2.3 The National Water Conservation Campaign (NWCC) in South Africa

Although rich in many natural resources, others are, unfortunately, scarce in South Africa. Notable among the scarce ones is water. With an annual average rainfall of 397 mm, far below the world average of 860 mm, rapid population growth, deprived rural access to clean water due to contamination of water resources and the destruction of important wetlands, Camp (1997:2) predicted a potential water crisis. In KwaZulu-Natal water-related problems that appear in newspaper headlines look disturbing. Mchunu (1998:1), for example, wrote that 30% of treated water goes down the drain and water waste was costing millions of rands. Msimang (1998:1) also noted that due to poor provision of water to rural areas, it was envisaged that big businesses which use water would have to pay for delivery to neighbouring rural communities.

To address the water resource problem in South Africa, the Department of Water Affairs and Forestry (DWAF) launched a Water Week campaign in August 1992. The timing was changed to 22 March in 1993, to coincide with the official date for the International Water Day (Camp 1996a:2). A National Water Conservation Campaign (NWCC) was launched as part of the policies of the Department, to create an awareness of the need to conserve and ensure clean water for all by the year 2020. The Minister of Water Affairs and Forestry motivated the NWCC to provide an opportunity for all South Africans to join together in an effort to invest in a

secure future through the responsible and efficient management and use of water. The Minister noted that:

> The Department of Water Affairs and Forestry's National Water Conservation Campaign was an initiative to promote equity, efficiency and sustainability in the supply and use of water in our country. However, it cannot succeed on its own. Partnerships must be built (Kader Asmal 1996).

Partnerships to be built, according to Camp (1996b:1), included a collaborative educational programme, extensive research and field trials, water management incentives, disincentives and regulations, with a two-way communication programme being essential. He added that to develop a greater public understanding of water management and water related matters, crucial issues to consider were water literacy, attitudes, behaviour and the need for skills development.

2.3.1 Vision 2020

In 1996, the 2020 Vision Project was launched, as an educational arm of the NWCC. According to Holtman (1996:3) the vision was to create in all South Africans, especially the youth, an awareness of the importance of water in their lives. It was also to instill in South Africans the need to be able to protect and manage resources effectively and to ensure clean water by the year 2020. Holtman (1996:3) noted that, in fulfilling the vision, the youth were encouraged through school projects not to waste water by leaving taps running or polluting rural catchment areas. The vision was to be transmitted into reality by involving schools in water education projects through environmental clubs or class activity during National Water Week programmes.

2.4 Water Audit in schools

2.4.1 Rationale

According to McQueen (1996:3), visitors to the Kruger National Park in 1995 saved 73% of the amount of water previous visitors had used and thus saved money as they were charged a *user pay* and not a standard flat rate tariff.

The *user pay* approach to the use of water, being so successful in the Kruger National Park, has also been used successfully in Tendele in the Royal Natal National Park in the Drakensberg. McQueen (1996:3) noted that a central hypothesis seemed to have emerged from the *user pay* project, namely that nature reserves could be catalysts in changing the way people use resources, especially water.

With the *user pay* idea discussed above in place, a system seems to have been established to advance the aims of the NWCC and Vision 2020, which was to reduce the amount of water used. This also provided a sound basis for the Minister of Water Affairs and Forestry, Professor Kader Asmal, to initiate an educational programme that could result in massive savings in water, as well as substantial savings for schools and local communities (Manuel 1996:4). The programme involved pupils undertaking water audits at their schools and in their homes. According to Manuel (1996:3) the findings of an audit team at Westville Primary in Michell's Plain, Western Cape, were that as much as R 6 500 per annum was saved by converting their self-flushing urinals to user-operated urinals, which was an easy and an inexpensive change to make. The Westville Primary audit team also projected that water savings could save the school's community over R 60 000 per annum. This also formed a good basis and hence an ideal theme for the 1997 National water week for primary and secondary schools all over South Africa.

2.4.2 The National Water Audit process

The National Water Audit process is explained by Manuel (1997), who is the National Research and Development Officer for DWAF, as auditing water quantity and water quality. The two concepts are defined simply, for the comprehension of primary and high school pupils, as:

> ***Water quality audit***: measuring the quality of water to find out if it was unhealthy.
> ***Water quantity audit***: measuring how much water you use, where and how you use it (Manuel, 1997:3).

2.4.2.1 Water Quality Audit

To determine the quality of water in the schools or homes the class or club was divided into a number of groups at the discretion of the teacher/co-ordinator. Groups had to find answers to questions such as: was the water in the area clean and safe? Two activities were involved in finding answers to the question. Activity 1 involved a discussion of five questions and listing possible problems in the area.

The five questions were: Did people wash clothes or bathe in the river or spring? How far were the pit latrines or rubbish pits from the side of the river? Were there any dead animals in the river? If there is a spring, is it protected from livestock? And did people wash their hands in water that was meant for drinking?

These questions were to be answered by the pupils in each project team by interviewing people in the community, collecting water from pots in the local communities, from taps, river catchments, checking river beds for depth, silting and sedimentation, and taking down notes and contacting information resources before writing project reports.

Activity 2 involved a simple test, using the human senses of sight, taste and smell, to see if the water was safe to drink.

Water was to be taken from sources such as taps, wells, spring and the river, by filing a glass. The water was smelt, the colour noted and a determination of whether it was safe was done by contacting information sources for the good qualities of water. A report of the project was then written (For details of water quality project: Manuel 1997).

2.4.2.2 Water Quantity Audit

A water quantity audit day was set by the teacher/co-ordinator, and pupils notified. On the day of the water audit, the class or club was divided into groups. Audit record sheets were distributed to the groups. Containers for measuring the amount of water used were also provided. An audit table could, for example, contain the amount of water used (Manuel 1997:24). Activities for which the amount of water used in the home, outdoor and the school could be measured and included: hand washing; flushing the toilet; washing plates in the sink; brushing of teeth in the basin; bathing; and washing clothes. Outdoor activities included: watering the lawn or garden; dripping of taps; washing the car; washing the dog; and the amount of water used in swimming pools. At the school, the activities included: checking leakages; accounting for water for gardening; drinking; flushing the toilet and urinals. Readings were taken, graphs drawn and reports written showing the amounts of water used and noting areas for redress.

2.5 The greater Pietermaritzburg area schools' Water Audit projects

In the greater Pietermaritzburg area, The schools' Water Audit projects were co-ordinated by Umgeni Water in Pietermaritzburg, and the KNNCS in areas around Howick, Mooi-River, Hilton and surrounding suburbs, Nottingham Road and adjoining farm schools. Although some later claimed that they had not participated in the projects, in all, 40 schools were indicated by the co-ordinators to have taken part in the projects. A bucket with information and instruction booklets and water

measuring equipment worth R 300 formed the water audit kit supplied to the participating schools.

The KNNCS organised a one-day workshop for pupils and teachers of some of the participating schools in its area with Share-Net (Umgeni Valley) a week in advance of the arrival of the project kits, and Umgeni Water organised its workshop on the day the kits arrived. The purpose of the workshops was to train pupils and teachers in the use of equipment for the Water Audit projects. Computer information retrieval skills were imparted to pupils and teachers in the Midlands training workshops (O'Donoghue 1998).

2.6 Development of the information database *Enviro-Facts* for environmental education

2.6.1 Development of the *Enviro-Facts* database

In his thesis[12] Taylor (1997:84) reported that, following verbal and written requests from environmental educators, environmentalists and teachers for information on particular environmental issues, and a survey by the Wildlife Club News in 1990 on the more commonly requested environmental topics, the concept of simple fact sheets (*Enviro-Facts)* was developed. The *Enviro-Facts* are 60 fact sheets on, for example, pollution, conservation, water and environmental auditing. Each fact sheet provided an overview or orientating framework for a particular topic. The fact sheets aimed to be concise, up-to-date, easy-to-understand and were South African in perspective.

Each fact sheet also included a list of 'further reading' to allow the reader to locate more information on the particular topic, and in certain cases what one could do to ameliorate particular environmental problems. Also included are useful contacts,

[12]Almost all the information on the *Enviro-Facts* database was taken from this thesis.

such as the names and addresses of organisations active in each field covered (Taylor 1997:84). One of the fact sheets covered environmental projects emphasising some useful ideas for teachers.

Pick 'n Pay, a South African chain store, provided the impetus for the production of *Enviro-Facts* as they also required information on environmental issues. The South African Nature Foundation (WWF-SA) provided funding for the project, while KNNCS originated and edited the work. Pick 'n Pay paid for the initial printing and distribution and the Wild life Society and the Environmental Society provided further distribution opportunities through Share-Net.

Taylor (1997:85) indicated that teachers and pupils who were prospective users were also involved in the early development process to ensure that the materials developed were appropriate and suitable to their needs. A series of development and feed-back workshops were held throughout South Africa, and these included conservation officials who regularly dealt with the public and the schools. According to Taylor (1997:85) constant interaction with users of *Enviro-Facts* had led to many constructive comments and useful ideas for revision. To make information from the fact sheets as widely available as possible, the sheets were copy-right free, A4 paper size folded to A5, and loosely bound so that they could easily be taken apart and photocopied. The fact sheets are also available on a computer diskette, making it possible for teachers and other individuals to selectively copy the resources and develop them according to their needs and context. *Enviro-Facts* were not only being used in primary and high schools but have been popular information sources in support of environmental education workshops and courses offered by the Wild life Society. They were also adapted for use during the first Rhodes University-WWF International Certificate Course in Environmental Education, where a number of students were represented from other African countries. *Enviro-Facts* have also been placed on the Internet, making them available and accessible worldwide (Taylor 1997:86).

2.7 The KwaZulu-Natal Nature Conservation Service microcomputer project

Two aspects of the Water Audit projects in the greater Pietermaritzburg area form an essential part of this study. These are, firstly, pupils accessing information from microcomputers to write their projects, and secondly communicating their findings electronically via the Internet with as many other schools and pupils as possible. These issues are in line with a decision at an Environmental Education Association of South Africa (EEASA) meeting held in July 1996 in Stellenbosch. It was decided at that meeting that a local chapter of Global Rivers Environmental Education Network (GREEN), the global mother organisation of low cost water quality management programme, was also to be established in South Africa (Shreuder 1996:2).

Two important functions of GREEN were relevant to this study. The first was to promote and encourage networking between the partner projects and provide more effective support to teachers regionally and nationally. This may include a newsletter and electronic mail. The second was to co-ordinate local developments and initiatives with similar international projects and work towards establishing partnerships and links (Shreuder 1996:2).

Resource provision for historically disadvantaged schools in the greater Pietermaritzburg area had been inadequate, as stated earlier (NEPI 1992a; NCHE 1996; Radebe 1997). This prompted Dr Rob O'Donoghue, a Senior Education Officer at the KNNCS to embark on a microcomputer project named *Water Indaba* to resource black schools for a wider use of information resources and a partnership in the sharing of information between schools with no computers and those which had computers on water education, in line with the objectives of GREEN. "The *Water Indaba* project was also intended for information sharing and as a preceding project for the DWAF's Vision 2020 schools' water projects with independent (private) schools, ex-NED schools, HOD and DET schools" (O'Donoghue 1998).

Masuku (1996:4&5) recounts that schools in the Umgeni River catchment area had started a water *Indaba* and had used e-mail to communicate with each other. The project was being co-ordinated by the KNNCS and Share-Net (Umgeni Valley). De Lange (1996:6) indicated that the *Water Indaba* project was in line with the objectives of GREEN to make information available to as many pupils and teachers as possible and also communicate on water projects. GREEN, concerned with water quality monitoring education, which it began in the Great Lakes region of the United States of America by the mid 1980's, had spread to over 20 countries world wide (de Lange 1996:6).

Funding for the *Water Indaba* pilot project was provided by the Department of Water Affairs and Forestry to St. Joseph's school (now known as Sibongumbomvu Community School). Because of the success of the project it was extended to three other schools in the Midlands area. Four Apple Emete computers thought to be more robust[13] were ordered from the United States of America due to the constant breakdown of the *386 computers* used earlier at Sibongumbomvu Community School. The remarkable initial progress of the *Water Indaba* project at Sibongumbomvu Community school encouraged the KNNCS to extend the project to other schools at Howick, Mpophomeni, Michaelhouse Farm School and Mooi-River as part of the National Water Audit projects (O'Donoghue 1998).

2.8 Summary

In this Chapter the background of the Water Audit project, which formed the basis for this study, was discussed. The discussion focused on the importance of environmental education, the National Water Conservation Campaign (NWCC) in South Africa, Water Audit in schools, the greater Pietermaritzburg area schools' Water Audit projects, the development of the information database *Enviro-Facts* and, finally, the KwaZulu-Natal Nature Conservation Service microcomputer project.

---

[13]The Apple Emete computer is robust in the sense that unlike the desktop computer it has an attached screen like the lap top, it is also portable because it is lighter than many lap top computers, and made of plastic that will not easily break when it falls.

Chapter Three
Literature review

3.1 Introduction

Chapter Three presents a review of the literature on microcomputers and associated resources as information retrieval tools generally, and in education, specifically. The microcomputer, databases, the Internet and the World Wide Web (WWW) as information sources for education are discussed. This is followed by a brief discussion of microcomputers and text-based information sources. Issues relating to information retrieval from microcomputers for education are examined, after which skills required for information retrieval from microcomputers and related systems, and skills required for information use, are discussed. The use of the microcomputer as an information retrieval tool for school projects is also discussed, followed by an overview of the availability of microcomputers and associated resources as information retrieval sources in schools in South Africa and KwaZulu-Natal.

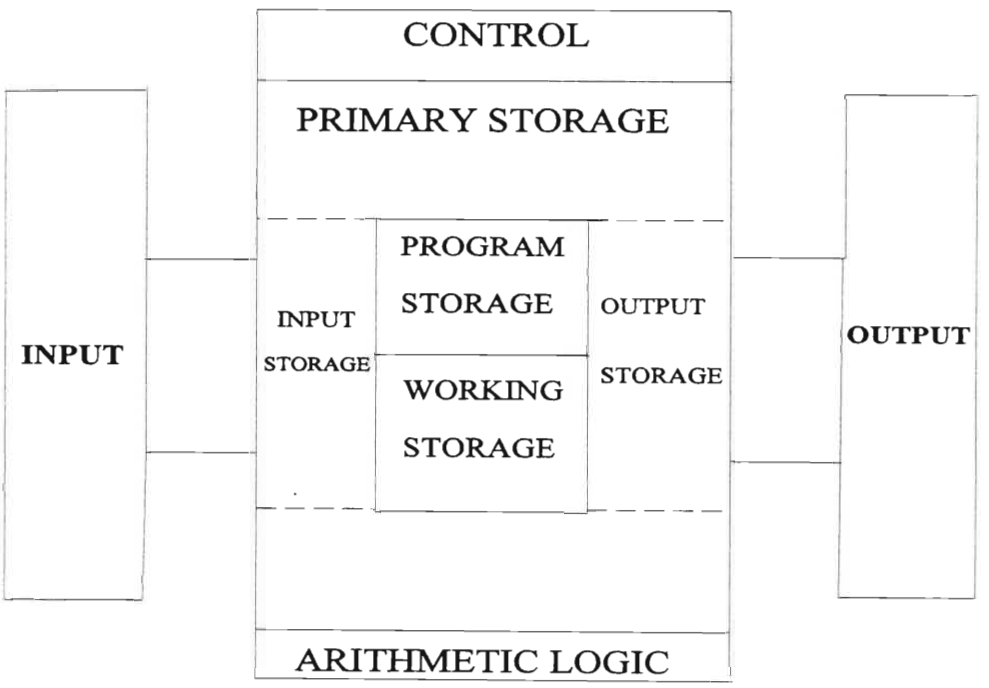
3.2 The microcomputer, databases, the Internet and the World Wide Web (WWW) as information retrieval sources in education

3.2.1 The microcomputer - a description

The microcomputer, from the definition in Chapter One, is a machine generically derived from the computer. The computer is made up of two parts, namely the hardware (the physical part of the computer), and the software (systematic instructions that enable the computer to function as a user would like it to).

According to Herring (1987:1), there are three main types of computers: mainframes, minicomputers and microcomputers. Mainframes control the computing applications of very big institutions such as universities, the army and big companies. They are very expensive and require dedicated staff to operate and maintain them. Today, due to improved computer technology, minicomputers which are lower in capacity and cost are able to perform limited tasks of mainframes with fewer staff. Microcomputers (also known as personal computers or PCs) are also able to perform limited functions of minicomputers. A simple diagrammatical representation of the microcomputer is provided by Govender (1990:135) as follows:

Figure 1 The Central Processing Unit (CPU) of the microcomputer



Source: Govender (1990:135)

According to Govender (1990:135), the central processing unit (CPU) consists of the primary storage, arithmetic logic and control elements. The primary storage or main memory serves four basic functions, in that it contains:

- a program storage area that holds the processing instructions;
- an input storage where data is held until it is ready to be processed;
- a working storage space that holds the data being processed and the immediate results of such processing;
- an output storage area which holds the finished results of the processing operation until it can be released.

In a research report by the South African Institute of Distance Education (SAIDE Report 1998:1-2), a list is presented of media technologies that are able to enhance the educational process, namely overhead projectors, Internet access, video, audio, multimedia and Compact Disc Read Only Memory (CDROM). Interestingly, all these technological delivery systems are to a large extent deliverable using the computer. This is an indication of the extent to which the microcomputer can be used for information delivery and in enhancing the education process.

3.2.2 Microcomputers as information retrieval tools in education

Thorpe (1984) and Neuman (1997), among others, traced the development of the use of the microcomputer in education. Thorpe (1984:213), for example, observed that developments in microprocessor (chip) technology brought about large-scale reduction in the physical size of computers, increased their reliability and speed, decreased their cost and enhanced their processing capacity. He noted, further, that with the aid of the new technology literature searching had been converted from a rather tedious task of sorting through card catalogues or printed indexes to a stimulating interactive process using online connection to remote databases, often located in computer centres thousands of miles away. Neuman (1997:687), in fact, suggested that the coming into being of the computer revolutionised learning related

to accessing, evaluating and using the information resources in a digital library environment.

Harter (1986:1) stated that with billions of pieces of accumulated data, information, knowledge, and wisdom of mankind stored in different places and formats, the need for a piece of information relating to a task at hand involved an ominous undertaking requiring a great deal of effort and time. Beswick (1989:7) noted that one simple problem with information was access. "In spite of all catalogues, bibliographies and interlibrary-loan facilities, people were still daunted by what was available, how you found out and the time it took to get it" (Beswick 1989:7). However, using microcomputers for information retrieval enabled prompt, convenient, reliable and effective means of accessing current information for all activity, including education.

Drost (1998:23) noted that technology education (TE) is not merely vocational or technical training. It deals with the development of self-confidence in the real-life environment. He believes that TE and environmental education (EE) both require similar interdisciplinary slots in the school curricular being developed all over the world for the new century from pre-school level to adult basic education. Both, he also noted, require an interdisciplinary, multicultural, holistic approach, aimed at educating the human race for the challenges of the new millennium.

Schlessinger and Karp (1990) presented data on uses of microcomputers in support of education in various areas of public schools in Texas and Pennsylvania in the United States of America. Their surveys showed that the availability and use of microcomputers was increasing in public schools, generally, and in school libraries, particularly (Schlessinger and Karp 1990:46).

3.2.3 Microcomputer databases as information retrieval sources in education

Computer databases are structured information sources which provide required information through unique access points known as fields. According to Williams

(1987:50) the creation of computer databases has become important in schools today because of the move towards independent and lifelong learning. Williams (1987:50) pointed out further that with the creation of databases in schools, learners far and wide had access to information. Through the use of library databases learners are motivated in their studies, able to develop skills of finding out, identify the purpose of information and be able to retrieve and use it. Harter (1986) and Williams (1987) concurred that microcomputer databases have had a positive impact on information retrieval. Harter (1986:2), for example, maintained that the computer and its associated hardware-terminals, communication lines, modems and complex software packages, facilitates prompt storage and retrieval functions of information on databases. Williams (1987:50) noted that microcomputers are used to store information in the form of databases in a way which provides rapid, flexible and specific access through appropriate index terms thus, meeting the needs of potential users.

Tenopir (1995:34) reported that the availability of, and demand for, full text databases had accelerated rapidly in the last five years, noting that full text was the most common type of database online. Putting full text in context, Tenopir (1995:34) indicated that databases no longer meant American Standard Code for Information Interchange (ASCII) texts without charts, graphs, photographs, and the like. "New image compressors such as Adobe and Acrobat were allowing online display of text that retained aesthetic features of print" (Tenopir 1995:34).

Pirkola and Jarvelin (1996:199) indicated that full text databases were in the form of news, newspaper articles and scholarly journal articles. They noted that Information retrieval in operational text databases is based to a great degree on the same methods as retrieval in bibliographic databases, with minor differences in the importance of some operators and frequent non-availability of controlled vocabularies for searching. Barclay (1996:58) wrote that databases often consisted of records and whole units of information such as citations, citations with abstracts, or full text documents. These records, they noted, were usually divided into fields of smaller units of information such as author name, journal title and date of

publication. These units (fields) then served as means by which the records in the database were retrieved.

3.2.4 The Internet and the World Wide Web (WWW) as information resources in education

As noted earlier in Chapter One of this study, the Internet was considered a major source of information for the greater Pietermaritzburg schools' Water Audit projects. Indications also seem to point to the fact that the Internet, as indicated by Welch *et al.* (1996:12), may be the information resource and communication medium for schools in the future.

3.2.4.1 The Internet as an information resource in education

The Internet, which is basically a connection of many computer networks, began life as an academic and research network sponsored by the United States Government. It is defined by the SAIDE Report (1998:5) as a global network of networked computers. Gwyneth, Poulter and Hiom (1996:iv) noted that, apart from the provision of hitherto unparalleled access to data and information in the form of databases, reports, electronic texts and much more, its greatest asset is the connection to millions of other users, providing opportunities to communicate, disseminate and seek information with people across the world.

According to the SAIDE Report (1998:5), the Internet is dynamic and continues to grow. Originally text-based, the Internet now supports transfer of multimedia data, including graphics, sound, video clippings and text. The SAIDE Report (1998:6-7) provides a list of a variety of educational information sources and information retrieval tools available on the Internet. These include Gopher, WWW, library resources, electronic archives, images and sound. Barclay (1996:89-97) noted that basic information and communication facilities available on the Internet included Telnet, file transfer protocols (ftp), Gopher, the electronic mail (e-mail), news groups

and the WWW used to navigate cyberspace[13]. While Microsoft Internet explorer is the most popular Web browser in South Africa today, Simeone (1996:27) listed Netscape and Mosaic as some of the popular educational Web browsers. The SAIDE Report (1998:21) added that Ananzi, Yahoo, Lycos, or Excite were important search engines which could be used to access educational material for education in South Africa.

3.2.4.2 The World Wide Web (WWW) as an information resource

According to Horton and Ilcheva (1995:99) the WWW is an open, unifying, boundless, seamless system of mankind's electronic information resources aimed at information retrieval and information sharing. They indicated that the Web includes all the other information systems on the Internet, which enables the user to travel the whole of cyberspace by the press of a few keys or the clicking of a mouse.

The SAIDE Report (1998:6) defined the WWW as a decentralised repository of information that housed Internet resources on computers. Simeone (1996:27) wrote that the WWW is the fastest-growing part of the Internet. She noted that it is made up of thousands upon thousands of pages or sites, complete with text, graphics, video and sound, with hypertext connectivities so that one could easily point and click his or her way.

Information can be posted to the WWW by anyone who can gain - or buy - access to a computer that has been set up to function as an Internet server, and the common languages used on the WWW are Hypertext Markup Language (HTML) or Java (SAIDE 1998:5). Connection to the Internet is an easy process. According to Simeone (1996:27) it is done with a modem and a transmission control protocol/ Internet protocol (TCP/IP) Internet connection plugged into a telephone line. Access to the Internet is established by dialling up to a service provider using a conventional or cellular telephone line and a modem, and Internet service providers are usually

[13]Cyberspace is the world "out there" occupied by the messages, files and data that circulate around the Internet.

connected by a physical pathway to the Internet, using a TCP/IP suite (Simeone 1996:27). According to Carvin (1998:1), however, the WWW has largely been ignored as a powerful educational tool, and on-line classrooms were few, with recent reports (according to him) suggesting that less than three percent of schools have Internet access. He noted that with its recent expansion into academia students have an opportunity not only to create their own complex learning environments but to present such an environment to fellow students, teachers, friends and parents at home. He noted also that the Web presents an excellent medium for students to organise and publish their own projects.

3.2.5 Advantages of the Internet and the WWW as information resources in education

A number of authors (Clyde 1995; Gwyneth, Poulter and Hiom 1996; Carvin 1998; the SAIDE Report 1998), have stressed the importance of the Internet as a resource in education. According to Clyde (1995:26), the growth of the Internet as an education resource in Australia had been so rapid that it was difficult to keep track of new services. She added that though many teacher librarians had not heard of the Internet three years before, "cyberspace was the place to be now" (Clyde 1995:26). She noted that through the Internet students and teachers had access to information from across the world, to a wide range of resources that enrich the school environment, and teachers could make contact with fellow teachers and subject experts in their own countries all over the world. She indicated that "by searching online, students don't only have access to current information beyond what was available within the walls of their school, but also acquire important information skills. And by taking part in cooperative school projects pupils could improve upon communication skills and improve their awareness of and knowledge of the World" (Clyde 1995:26). According to Gwyneth, Poulter and Hiom (1996:91), the power of the Internet as an information resource lay in the free information that was easily available, accessible to the public at large, in a huge diversity of material, aimed at all subjects, at all levels, and all types of users. Clyde (1995:28) noted that through the Internet, students and staff are able to obtain the latest research and information

on any topic, search and retrieve from thousands of libraries, access a vast bank of educational software, obtain the text to thousands of books, periodicals and research papers on any topic, and develop more independence and autonomy in their learning situations. Carvin (1998:1) argued that passive learning does not work, yet interactive learning works wonders, and empirical analysis supported the interactive nature of the learning process through the Internet WWW.

The SAIDE Report (1998:20-21) listed the educational potentials of the Internet which could enhance the practice of teaching and enrich the curriculum of schools as:

> encouraging the development of professional communities of educators;
> challenging and inspiring learners;
> expanding personal knowledge;
> encouraging interpersonal connection and interactive knowledge;
> preparing learners to participate in the modern workforce and
> empowering learners to take charge of their own learning.

The SAIDE Report (1998:21) states that :

> The Internet could simply be used as an additional source of information - as an extension to the library or resource centre. It could be used as a learning resource that is occasionally structured into the curriculum. In this case, its occasional use could be for research into a topic, for a lesson that has been based on a Web site (or a number of Web sites), for a collaborative project with learners elsewhere, or for a virtual field trip. Virtual field trips have the potential to put learners in contact with real sites of research or exploration, and to provide them with an opportunity to see what researchers are doing without incurring the expense of physical travel.

Carvin (1998:1) suggested steps to be taken in order to further the development of the Internet and the Web in schools. These steps are:

> institutional access to the Internet must increase dramatically;
> more community networks and free-nets must begin to offer Web access at reasonable rates, and must offer schools server accounts to publish their Web sites;

- members of the community who already have access and experience should offer their assistance to demonstrate to others what the Web can do and its simplicity;
- increase in the number of volunteers to provide knowledge to those who lack it.

3.2.6 Arguments against the use of the Internet and the World Wide Web (WWW) as information sources in education

The Internet and the WWW is not without its critics. Authors such as Morgan (1995), Barclay (1995), Gwyneth, Pouter and Hiom (1996), Welch *et al.* (1996), Jackman (1998) and the SAIDE Report (1998) have all indicated their misgivings about the Internet. Morgan (1995:14), for example, defines the Internet as a "huge mass of poorly organised information and disinformation". He saw locating and retrieving information on the Internet as hard to find as the proverbial needle in the haystack. Barclay (1995:87) summarised the cause of the disorganised information resources of the Internet as follows:

> Truth is, almost anyone with a connection can publish whatever they want on the Net. The lack of gate keepers - one function of the print-based publishing community has both advantages and disadvantages. On the good side, people have access to ideas and information that otherwise might be unavailable; on the other hand, no one entity is responsible for verifying facts and evaluating the usefulness of files to ensure any standard of quality, hence a lot of junk out there in addition to the gems.

Gwyneth, Poulter and Hiom (1996:91) noted that there are no clearly-defined search strategies nor manuals which document resources on the Internet. They were also concerned that though the Internet should be seen as an addition to the existing range of information sources, its very nature made it unreliable for quick reference. They noted that knowing a site and having the necessary computer system to

access it did not guarantee that the site was operational or the Internet connection would be functioning at the time one needed it[14].

There was also the possibility that computer viruses[15] could interfere with computer programs, thus rendering impossible information retrieval from files. Flagg (1997:215) reported two incidents in the United States of America in which library Internet services had to be closed for some time. In one incident a hacker[16] continuously stored through the Internet computer files on the server of the library thus filling the memory of the server. In another, a patron of the library either intentionally or unwittingly[17] contaminated the entire library computer system with a virus. Both library services had to be restored by rebuilding new systems at considerable cost.

While accepting that the Internet will be a beneficial part of the educational environment, Welch *et al.* (1996:12) also warned that it was unorganised, anarchic in nature, making planning for use difficult. The SAIDE Report (1998:21) warned that the WWW could easily be misused to cut and paste reams of information with little thought, particularly where assessment activities encourage regurgitation of information rather than its contextualization and application. The report noted that the Web could simply be used to disseminate teacher focused lecture notes, assignments and tasks, a model which suggested a mistaken assumption that education was nothing more than a process of information transmission and rote learning. Welch *et al.* (1996:12) pointed out other issues regarding the use of the

---

[14]This issue is best illustrated by the fact that the Umgeni Schools *Water Indaba* Website (http://www.futurenet.co.za/Indaba) has been deleted by the sponsors, who felt that response from schools on the use of the site was not encouraging.

[15]Computer viruses are programs that attach themselves to files so that when files are accessed, or programs are run, the viruses either duplicate themselves, alter some aspects of the system configuration, or destroy data (Eyitayo 1996:215).

[16]A hacker is a person who gains unregistered and thereby unlawful access to a remote networked computer system (Prytherch 1995:288). Such people introduce computer viruses into computer systems through the Internet.

[17]The coordinator of the Umgeni Schools' *Water Indaba* project indicated that one of the problems experienced was the constant bugging of the computer with viruses picked up from pupils' diskettes.

Internet. These included problems regarding initiating its use in schools, technological problems and networking. It was also reported by Jackman (1998:3) that children addicted to the Internet who spent hours at the computer could end up with spinal deformities. Karaliotas (1997:6) pointed to the sense of alienation and isolation as some of the drawbacks to being addicted to the Internet in the use of computers as an educational tool. Other implications of using the Internet, according to Gittner (1998:1), were supervision of pupils as they surf the Web, phone bills, pupils accessing pornographic sites, pupils' ability to assess the appropriateness of the information they access, and the possibility of Websites being deleted without the knowledge of an information retriever.

Welch *et al.* (1996:12) suggested that a solution to some of the problems of the Internet was that the issue of information literacy needed to be tackled in more depth, as this underpinned the use of the Internet as an information retrieval tool. This point is made more poignant by revelations from a survey they conducted on the preparedness of schools to take up the challenges of using the Internet - the greatest problem highlighted in the literature and verified in the results was the need for the training of teachers and pupils in the schools. One can therefore not agree more with the SAIDE Report (1998:22) that the strengths and weaknesses of a specific technology are not necessarily intrinsic to the technology itself but are frequently indications of the uses to which they are put. As pointed out by Beswick (1989:7), the new information technology also requires mediators, and using it does not suddenly invalidate all one knows about the old.

3.3 Microcomputers and text-based information resources

As computers continue making an accelerated and positive impact on information retrieval and in education, writers such as Lancaster (1977), Neuman (1990), Kurzweil (1992) and Eco (1996) were beginning to question the future of books. While Lancaster (1977:13) has conceptualised a future information system in which

scientific and technical communication will be completely paperless by the year 2000, Irving (1988:13) predicting the media centre of the future being completely portable and electronic, and Kurzweil (1992:80) predicting that the day of the virtual book was not far away, Eco (1996:3) agreed with Beswick (1989:10) that the appearance of new means of information provision does not lead to the destruction of earlier ones. Eco (1996:3) believed that the new technology would free the old from one constraint or another, thus suggesting that technology will not destroy the book. He gave the example of the arrival of photography and the fact that the art of painting had not died, and maintained that books that might disappear were types that people had to browse through such as encyclopaedias, grammar books and atlases. The ones that would survive, he noted, were the ones that were read from cover to cover, notably novels. He concluded that the book is one of those inventions of which no better ergonomic substitute has been found. His reasons were that it fitted well in the hand, could be read in almost any situation, even by the light of the candle, and in bed, in a way that put memory and imagination in motion. The dialectics of the situation is echoed by Kurzweil (1992:80) who argued that the present information age threatens to dethrone the older technology, with the enthusiasts, prematurely predicting victory. The conservatives, finding certain elements of non-functionality, present those as evidence that the original technology will indeed last forever.

Neuman (1990) and Eco (1996) have been pessimistic about the impact of the new information technology on society. Eco (1996:3) noted that, though the new media technology had restored a dynamic balance between media and text, its provision of an over-abundance of information could lead to a destruction of information. He argued that there was little difference between having a million megabytes of information at one's disposal and having nothing at all. He also agreed with the pessimists of the information age that society would be divided into classes where the haves of information technology would be able to analyse and distinguish between news and "babble", creating a situation reminiscent of George Orwell's "1984". Neuman (1990:159) pointed out that the advent of the emerging

technologies will signal an unbridgeable widening of the gulf between those who are in society's main stream and those who, for whatever reason, are in the eddies.

3.4 Issues relating to information retrieval from microcomputers in education

3.4.1 Positive impact of microcomputers on pupils in education

The mere use of microcomputers is a delight to children and a means of keeping them fully involved with this information retrieval tool. Mossom (1986) related his personal experience of pupils' eagerness to attend computer lessons and how they were captivated by the use of the microcomputer. He reported on schools he visited during computer lessons that "at all schools, pupils were eager to attend these classes. They were at the door before teachers and were reluctant to leave at the end of the lesson, even at tea break".

Pupils' eagerness to use computers reinforces the point made by Herring (1987:13), that the use of microcomputers for pupils to retrieve information for curricular work in schools today will lead to their improved overall performance. He added, however, that microcomputer use required information skills which all pupils should acquire as the information skills (retrieving required information and being able to use it for curricular work) ensured that the microcomputer is seen as a tool to enhance their learning. Olën (1989:45) believed that it was important for pupils to learn to use microcomputers for information retrieval so that they could operate effectively in modern society. Todd (1997:12) noted that "a sound understanding of computers and information technology with a pedagogy centring on developing students' knowledge and skills to manage, process and utilise the enormous variety, quantity and variable quality of information that IT provides was required in schools today".

He presented the findings of a 1996 study[18] of 500 students in 28 fourth grade and sixth grade classes in the United States of America. The study showed that students with online access to information performed better than those without such access. He believed that teacher librarians could be key role-players in this regard.

3.4.2 Steps and techniques used to maximise information retrieval from microcomputers

A number of writers such as Harter (1986) and Large; Beheshti; Breuleux; and Renuad, (1994), noted that the task of information-seeking involves a strategy consisting of a number of steps. Harter (1986:13), for example, described these steps as discrete components to be carried out roughly in a given order. Large; Beheshti; Breuleux; and Renuad (1994:499) itemised these steps as follows:

1. Analysing the information problem in order to understand its conceptual structure;
2. Expressing the identified concepts in search terms;
3. Assembling the search terms into a search strategy;
4. Implementing the search strategy upon the chosen database by a retrieval engine;
5. Accessing the retrieval engine through an interface;
6. Evaluating the information retrieved to see whether it meets the needs of the user, and
7. Reformulating an interactive process by returning to any of the processes above if user is not satisfied with search results.

Harter (1986:14) noted that the steps should not be regarded as a linear algorithmic sequence. What is important is a holistic approach needed to derive useful search results. He saw communication as central to a search process if an intermediary was used, and noted that database selection also required extensive documentary consultation.

[18]This study is available at the website http://www.cast.org/stsstudy.html

3.4.2.1 Language command and keywords

Information retrieval performed in the information seeker's second language raises issues such as command of the computer language, command of keywords, the level of education and the level of experience. These issues are relevant and sometimes become contentious. Harter (1986:6), for example, noted that a problem arises with the search process when there is a distortion of meaning of words accompanying the conceptual analysis process. Large; Beheshti; Breuleux; and Renuad (1994:500) stated that what is most critical in an information retrieval process is the way in which the user conceptualises the search query and relates this to the database. They also pointed out that information retrieval involves cognitive activity. This, they noted, may be affected by personal characteristics such as knowledge, experience, information need and the information system comprising the database, retrieval engine and interface. Nahl and Harada (1996:199) pointed out that students often use natural language which is incompatible with the online catalogue's controlled language. Evidence from research conducted by Large; Bheshti; Breuleux and Renuad (1994:499) suggests that pupils' ability to use an information retrieval system depends upon their command of the language used in the retrieval engine. Their findings, however, did not support suggestions by Marchionini & Liebscher (1991) that students who performed better in computerised searches spoke better English, and children from higher socio-economic background perform better than those from lower socio-economic backgrounds. The study by Large; Beheshti; Breuleux; and Renuad (1994:501) also found that novice searchers can, with minimal training, use information retrieval systems that incorporated several retrieval paths.

Keywords also play a very important role in the information retrieval process. Herring (1996:76), indicated that keywords are indeed used when a search for information using online databases is conducted. Information retrieval from both computers and text sources is also contingent upon the use of the right keywords. Herring (1996:76) noted that keywords allow pupils to think through the chosen topic and pupils' identification of keywords established a firm link with their existing knowledge.

Using keywords correctly also depends upon the way in which they are combined. According to Harter (1986:76), many online search systems permit the formation of complex expressions by using Boolean logic (an algebra of sets of keywords). Barclay (1996:65-66) explained that Boolean operators identified as AND, OR and NOT are used to broaden or narrow searches. Harter (1986:76) earlier explained that AND was an intersection of sets or a combination of like terms of two items, OR is a union of sets or a combination of the elements of two different items with no repetition and NOT is a difference of two sets or two items.

The use of truncations is also helpful in maximising search results. Harter (1986:83) indicated that to truncate was to search on a piece of a longer word or phrase. By so doing the searcher indicates a willingness to accept any terms of the specified word as closely as possible. According to Barclay (1996:65) truncation symbols vary from database to database but common ones include: *, !,?, and $. Harter (1986:83) indicated that truncation either precedes, or comes after, part of the beginning of the word. He cited an example of a truncation thus: if the truncation was @ and the word was library, a term lib @ would retrieve all words including library, librarian, libraries, librarianship and others of that nature.

Nahl and Harada (1996:199) noted that a critical conclusion in many studies was that the mechanics of computer searching[19] are not the major stumbling blocks in effective information retrieval by pupils. Concept and term identification and confusion in understanding of Boolean operators are definite hurdles. According to Gwenyth, Tseng and Hiom (1996:45), information retrieval from the Internet and the WWW is sometimes possible using text retrieval techniques such as keywords, truncation and Boolean logic.

Neuman (1995:286) stated that the major problems students encountered in using electronic information sources were in generating search terms, designing effective

---

[19]Mechanics of computer searching is used in this context as the interactive process of using the computer hardware to implement a search strategy upon a retrieval engine by inputting (data) keywords and using the hardware and software to retrieve information.

search strategies, and overcoming mismatches between personal words and ideas and how the information was organised in databases. According to Nahl and Harada (1996:199), a lack of information retrieval skills underscores students' lack of general information seeking strategies. In their research Nahl and Harada (1996:203) found that students who reported that they were more experienced in using computers performed significantly well in the search process, while, on the other hand, students who reported less experience with computers had significantly lower confidence which negatively affected their performance in the search process. They advised that self-confidence is an important factor in a search process and should be developed and strengthened in pupils.

3.5 Skills required for information retrieval from microcomputers and for information use in education

3.5.1 Computer skills for effective information retrieval from microcomputers

A computer, as with every machine, requires skills for it to be operated and used effectively. According to Borman (1995:31), schools of thought that computers and programming were synonymous with computer literacy, would be saying that driving should be preceded by a course in mechanical engineering and carpentry by a course in wood technology. This study relied on the definition of computer literacy by Beswick (1989:8), that "computer literacy was not just being able to handle a keyboard, but understanding the active uses of the computer in retrieving, reworking and creating information". Herring (1996:25) viewed computer retrieving skills as low-level mechanical skills which pupils should not find difficult to attain, thus supporting the findings of Large; Beheshti; Breuleux and Renuad (1994), that novice searchers are able to use an information retrieval system that incorporates several retrieval paths with minimum training.

Computer literacy is becoming a condition for playing a meaningful role in today's world. Campbell (1996:14) was of the opinion that learning environments are now dominated by computers, and curricula have changed in response to new means of accessing information. She noted that classroom-based, textbook-oriented and teacher-directed learning cannot prepare students for the sort of future dominated by technology and the proliferation of information. Mbeki (1996:39) called for the formation of a national foundation of education and training, with principles focussing on personal growth development, lifelong learning and the introduction of a basket of IT skills in schools. Todd (1997:11) noted that the real learning revolution was now starting where educators are beginning to use information technologies to provide learning experiences that are qualitatively different from their predecessors.

With information expanding at an exponential rate, Campbell (1996:14) noted that students need a new *electrographic literacy* to assimilate, digest, absorb and express the huge quantities of information that are now available through the emerging electronic technologies. Johnson and Eisenberg (1996:13) pointed out that computer skills in most schools were taught as isolated subjects limited to students choosing certain courses. They advised teachers and school administrators to recognise that computer skills taught in isolation in separate computer classes do not help pupils but must be taught in integrated and meaningful ways across the curriculum. According to Sprainger (1997:27), students need to understand that a computer screen is more complex than a page in a book. A screen, unlike a page, has, in addition to the text, instructions and navigational aids. Students would need to become familiar with such conventions as icons, menu bars, outlines, book-marks and coloured hypertext which are used to navigate between screens. She stated that considerable explicit instruction needs to be provided in using category menus, online indexes and simple and advanced keyword searching, and cut and paste from the Internet to word processing is required to discourage useless print-outs.

Campbell (1996:14) is of the opinion that teacher-librarians must take the lead in developing this new information technology literacy, especially among teachers. She argued that when teachers were effective and informed users of information

services and technologies, they would influence the information-related learning outcomes of students. Johnson and Eisenburg (1996:12) are also of the opinion that teacher librarians must not only begin to provide the knowledge, vision and leadership to the critical area of physical access to computers but also intellectual access. They added that "teacher librarians must provide information on the integration of computer and information skills for information problem solving in the school environment". Shoolbred (1990:44), writing on *IT and the school librarian*, noted that IT could make the teacher-librarians' work more interesting and demanding, raise their profile, but marginalise them if they fail to take a lead. Todd (1997:12) made a plea to teacher-librarians that they need to have a clear understanding on how search engines are indexed, abstracted and operated, and to communicate this to classroom teachers and students through carefully designed learning activities. He added, "Unlike AACR2[20], descriptions of materials in school library catalogues which provide consistent and accurate access, the search on the Net provides access in a unique and inconsistent way to their databases and material" (Todd 1997:12).

Shoolbred (1990:44), however, pointed out that in many schools the IT equipment was in the hands of the computer or business studies departments, who show very possessive attitudes. She added that colleagues from the school library, mostly women, are defensive against their often male counterparts in such departments. This suggests that media teachers in many instances lack the confidence to discharge their duties of providing information to pupils, as indicated by Radebe (1997:21).

[20]AACR2 is an abbreviation for Anglo American Cataloguing Rules used for cataloguing library materials.

3.5.2 Traditional information skills for information retrieval and information use

Writers such as Irving (1988), Beswick (1989) and Nahl and Harada (1996) have urged caution about the new information retrieval technology. Irving (1988:10), for example, was of the view that the major problem faced by those for whom the information society will be the status quo, is not that of acquiring information, but of rejecting the unnecessary and manipulating the essential. Beswick (1989:7) argued that access to the technology alone might not be the problem. She noted that it would be naive to think that a person who has difficulty in reading and understanding one book will find reading five million easier, as technology will bring about a heavy saturation of information systems old and new. Beswick (1989:7) stated that:

> ... the problems would surely not be very different. Pressing the button is the least of them. One needs to know which buttons to press and in what order, using what terminology, and having found the page on the screen, there is still the problem of decoding, determining the different kinds of and levels of meaning, (some of which may use languages that are different from ...our home).

In the opinion of Nahl and Harada (1996:199), the key to the use of these new information sources for information retrieval lies in the students' ability to analyse problem statements and adopt problem-solving strategies in constructing search statements. They noted that this analysis involves higher-level thinking skills to retrieve, select and evaluate information required in breaking down a topic into its key concepts or facets.

Thus, whether information is paper or electronic based, skills are required and should be mastered to ensure retrieval and effective use. Herring (1996:16) defined these information skills as "skills which pupils use to identify the purpose of, locate, process and communicate information, concepts and ideas and then reflect on the effective applications of these skills". Eisenberg (1992:103), writing on a change in paradigm in library and information skills, stated that "the new emphasis is on developing transferable cognitive skills that should increase students' effective use

of information in general, as well as their use of libraries and resources". Jackson (1994:25) specified these cognitive skills as locating the information, analysing and interpreting the information, synthesising and organising the information, using the information and evaluating it either in terms of its quality, suitability or relevance for a specific need.

Herring (1996:17-24) examined the works of the influential seven models of information skills. These are the Marland model, the Exit model of Wray and Lewis, the Big Six models of Eisenberg and Berkowitz, the United States National Council for Educational Technology (NCET) model, Irving's model, the 1980's model by Tabberer, and the Australian model. Reviewing the models, Herring (1996:24-25) concluded that:

> Information skills must be regarded as a number of interrelated skills which should not be isolated from each other;
> information skills are essentially thinking skills which should not be viewed as technical skills, and irrespective of the type of information resources being used:- print, audiovisual, or electronic - there was little difference in the information skills needed by pupils to use these resources effectively.

With the onset of the information revolution, Eisenberg (1992:103) wrote on the guidelines for school library media programmes *Information Power,* set in motion by the American Education Authorities[21] in 1989. These guidelines had a mission:

> To ensure that students and staff are effective users of information that would provide intellectual access to information through systematic learning activities which develop cognitive strategies for selecting, retrieving, analysing, evaluating, synthesising and creating information at all age levels and in all curriculum content areas (Eisenberg 1992:103).

Herring (1996:26) also reported on a project conducted by the United States National Council for Educational Technology (NCET), which examined the impact of using multimedia and the Internet in schools. It was found that planning online

[21]A leading role was played by *The American Association of School Librarians* and *The Association of Communications and Technology* in the preparation of this document.

searches was vital. In terms of finding information, the project reported that:

> The same retrieval skills are used with new electronic sources as with print;
> planning and refining searches was critical with electronic media;
> pupils in some projects combined retrieving from both electronic and print sources of information;
> retrieving information from the Internet was time-consuming and often difficult;
> the type of information retrieved from the Internet was often unsuitable for curriculum use.

Johnson (1995:10) pointed out that the Internet user has a challenge to select useful data from the glut of information on the over 11 million computers located all over the world. He identified a number of skills which pupils will need in order to make good use of the Internet. These include:

> knowing the difference between information and knowledge or insight;
> sorting and evaluating information and information sources;
> understanding the problem to be addressed;
> identifying what information is needed for a problem;
> knowing the need to be recursive when solving a problem;
> framing essential questions;
> identifying subsidiary questions;
> planning research;
> modifying the search when new information suggests it;
> synthesising information to create fresh answers and insights.

The effective use of the abundant information offered by the microcomputer system requires information skills, which are cognitive skills of understanding the problem to be addressed, knowing information that is required to address the problem, sorting and evaluating information and information sources, planning research and presenting research reports based on the problem. As pointed out by Behrens (1995:254-255), in the United Kingdom and the United States pupils are equipped with these information skills which are considered life skills, while they were yet a captive audience in the formal learning system and it is imperative that these skills are made part of the curriculum as South African education is ushered into the information age.

3.6 The microcomputer as an information retrieval source for school projects

Available literature (Beck 1982; Herring 1987; Olën 1989) suggests that the use of microcomputers for information retrieval in school projects originated from the Schools' Information Retrieval (SIR) project of the Association for Information Management (ASLIB). Wozny's (1982) investigation of ninth graders' online bibliographic databases in connection with an independent research project was one of the earliest studies in this field to draw attention to the potential of electronic information resources. He concluded that the study was not just to help young learners access information but to introduce students to a broader world of information and to provide a new opportunity for assisting them develop search strategies.

Davidson (1985:211-213) described a computerised information retrieval project embarked upon at the Bridge of Don Academy by the school and the media centre on conservation and pollution using an Apple II microcomputer. This was one study available to the present researcher that related to the Water Audit projects[22]. The study, which was part of the Modern Studies curriculum, first involved the creation of a data file for use in the school resource centre. The Modern Studies teacher had prepared a set of class workbooks for "Conservation and Pollution" and he had underlined certain words in the passage. These words were chosen as the basis for the curriculum-based access keywords. A curriculum-based thesaurus was produced from the list of workbook keywords. From the thesaurus a keyword list was developed as a satisfactory indexing guide. Keywords from the index were assigned to pages as well as chapters and these were input into the Keyword Information Retrieval System (KWIRS). Two programs were developed: a complete program for use by the librarian allowing text files to be entered and searched and a shorter program for the pupils.

---

[22]The aims, objectives, curricular content and organisation of the Water Audit projects was similar to this project.

The information skills programme was developed when the data file was complete. On the invitation of the teacher involved, a course involving several lessons was attended by pupils and was used as a basis for information skills. The program concentrated on three categories of information retrieval skills. These were:

1 Selecting keywords: analysing the subject areas;
2 search strategies: synthesising (combining relevant keywords for in-depth retrieval and adjusting a search path when necessary);
3 manipulating the microcomputer KWIRS search which comprises:
   a. a tape slide programme of 'what do I do next' (providing a group introduction to information retrieval);
   b. a pupil hand-book '*Using the microcomputer in your project*' and
   c. a microcomputer program providing an opportunity to practise retrieval.

Each component of the information skills programme extended and reinforced the three main stages of keyword retrieval:

1 defining the subject area: finding keywords;
2 linking similar keywords: grouping keywords by concept
3 combining keywords to retrieve the exact information needed: search strategies.

It was noted that the actual retrieval process by pupils took little time in comparison with the time spent in helping pupils arrive at the stage of information retrieval. It was also noted that the concept of keyword retrieval was quickly grasped and the eagerness of pupils to experiment with keywords was apparent. Pupils were encouraged to plan their project around their retrieval of information so that at every stage of the project they would be considering the final product.

Describing another project based on the SIR project, Beck (1982) provided interesting issues arising from that project, as follows:

> The project was an all-inclusive school initiative and carried through by the whole school;
> the school provided the articles that formed the database;
> a course was held for the media teacher and other teachers for the project by ASLIB;
> as many teaching staff as possible were trained on the project and database;
> as many pupils as possible were also trained to use the microcomputer and the database.

Research by Kafai and Bates (1997) into Internet Web-searching in the elementary classroom, was also similar in many respects to the Water Audit projects. The research sought, among other objectives, to provide for pupils a context in which the search for and retrieval of information would no longer be an isolated experience. It would be connected to their classroom learning, to a larger social goal, and they would be able to share with other children the insights gained.

The construction of an information structure such as a directory for the project[23] was seen as a powerful way for the children to gain better understanding of existing web directories such as Yahoo. By observing the students the researchers were able to find answers to questions such as: Could children use the search engines currently available? Could they find appropriate resources in a directed search? Could they evaluate and use the selected resources?

The key concern of the project was the development of information literacy, which included: recognising the need for information; formulating questions based on their needs; identifying potential sources of information; developing successful search strategies; accessing the information and evaluating, and organising and integrating the information into an existing body of knowledge. The researchers wanted to establish that resource-based learning and technology fostered a non-directive teaching style in which the student controls learning within the framework of the

[23]The Website of that project is: http://www.gseis.ucla.edu/SNAP/snapdragon.html.

curriculum. This corresponds with suggestions raised earlier by Johnson (1995:10) and Karaliotas (1998:4) which stressed the relevance of resource-based methods of teaching which define the position of a teacher as a facilitator in the learning process, rather than as a knowledge source.

The project, dubbed SNAP Dragon, took advantage of a SNAP (Schools Network Action Project) population and ran concurrently with the University of California Los Angeles (UCLA) graduate interns who were to run Internet workshops at the schools. Each class had a different setup, a different number of students and a different search topic. The UCLA graduate interns received a number of intensive training sessions and instructions in both education and library and information science (LIS) and were instructed in the practical aspects of searching the Web in the classroom and the laboratory as related to the Dragon project.

All schools in the study had powerful models of Apple Macintosh computers, with Internet connections, and all classes searched on the Netscape browser. The student body was ethnically and socio-economically diverse. One of the first and second-grade classes was bilingual (English/Spanish). The search topics included: airports, ocean animals, black history or poetry, city buildings, national parks and ancient Egypt. Only the topic of national parks was not part of the curriculum in the SNAP schools.

Grade by grade findings of the SNAP Dragon project

In grade one it was observed that even students who could not read were able to find the pages required for the information related to their project. Pupils could easily click on a book marked URL[24] that related to their projects.

It was observed in grade two, a bilingual class, that students found a significant amount of information on their topics. This amount of information varied from one

[24]URL stands for Universal Resource Locator. It is the Internet address for Websites. It is used interchangeably with the term Website in this thesis. In library terms it is the call number on the spine of a book. It indicates the location of a page on the Web, for example. To bookmark a Website was to store that URL in the memory of the computer such that it is accessed readily.

species of animal to another. It was also observed that students found it difficult to type and typing was time-consuming as they made many typing errors. The teachers concluded that there was the need for mastering of keyboard skills before information could be retrieved effectively from the Internet.

In the third grade it was realised that the large number of computers which were used in the computer laboratory was an advantage to the students. Co-ordination from the lab instructor and the teacher was needed to bring sets of activities in the classroom and the computer laboratory into harmony.

What was quite noticeable during the search session was the disparity between students who had prior access and experience with the Internet and those who did not. The students with prior Internet experience tended to dominate the interaction and decided which sites to visit and how long to wait there before moving on. Such students were often boys.

In the fourth grade the project was concerned with the building of a city of the future, with different themes in a computer class. The search process was to critique the web sites, hence developing pupils' critical thinking skills. The research in this grade concluded that the children required support in their search processes because the number of students per computer was very high.

In the fifth grade, students spent most of their time discussing problems relating to their topic which was not integrated into the curriculum. Finding European parks was difficult as *European* was not a term for parks in individual countries in Europe. This result showed that children above the age of ten are able to find information on the Internet to a large extent and with little help from intermediaries. Their typing, spelling, vocabulary and Boolean logic skills did come into play, as the absence of this could limit their ability to find appropriate information.

In the sixth grade, in addition to reading from their text-books or consulting resources in the media centre, students used the WWW for finding additional

information on specific topics of their choice about ancient Egypt. The teacher was unfamiliar with the Internet, while the students were familiar with it. The probable reasons why these students were able to master the most sophisticated search techniques of all the classes were that most of the students had computers at their homes. Some of the students were familiar with HTML. They were divided into teams where Internet experts, evenly divided among them, became the teachers of the team.

General observations from the project and pupils' annotations are:

1 Many Web sites were not friendly, the use of words which children did not understand generated complaints from them;
2 children preferred sites with high visual content and short simple textual content;
3 children were inspired by sites that relate in a way to them, for example children's sites;
4 children would like to see more animation and interactivity on the Internet;
5 children have a low tolerance for long download times;
6 in viewing a site, children first decide whether the site was of interest to them before determining its relevance;
7 they gradually learnt to differentiate marketing sites from neutral ones;
8 many issues of difficult language came up;
9 the graduate interns served as *de facto* media specialists.

In their discussions the researchers strongly noted the role of the school media specialist. They indicated that the WWW searching was an obvious extension of the many other kinds of information searching that fall within the range of the library media specialists' expertise. They pointed out that the media specialists were also likely to master the technology and have a higher and more comfortable level of expertise with computers and their use than most other teachers in the school. The use of the Internet in the schools served as a natural source for media specialists to

provide the missing link between teachers and information resources to engage in incorporating the resource into the curriculum. They indicated that in one of the schools, the vice-principal approached the Intern about organising Internet workshops for the rest of the teachers. This supported the call by Campbell (1996:14) for teacher-librarians to take the lead in influencing information-related learning outcomes of pupils.

Conclusions from the project were: all children in first through to sixth grade were able to use Web sites to their advantage in learning. Other children could learn to use search engines and the rudiments of Boolean logic. Students were able to extract information for their school projects from the sites they visited. Selecting good sites was their problem. This was because it appeared they used only the titles to their projects to decide which sites to visit. Visiting irrelevant and boring sites retarded the progress of some of the students. Interest and enthusiasm soared when students realised that their annotations could be accessed all over the world. The researchers found that working with even one Internet accessible computer turned out to be feasible given certain good classroom arrangements. In general, the students' interest in the Internet activities was high.

It was observed by Neuman (1997:689) that growing research in electronic information resources (see, for example, Crane and Markowitz 1994; Neuman 1993; Neuman 1995) revealed a growing awareness that EIRs provided a critical venue for helping students learn concepts and skills that are essential in the information age. These were the abilities to access, evaluate, and use information to build knowledge, to think critically, and to solve problems.

As the Internet increasingly became a resource for education so was it also becoming necessary for a change in paradigm in teaching and learning models. Johnson (1995:10) pointed out that only certain types of teaching methods will make effective use of Internet resources. These he listed as: resource-based teaching; constructivists teaching; authentic teaching and learning; and project-oriented education using authentic assessment. Karaliotas (1997:3-4) supported the view

that one of the implications of the use of the Internet in schools is that learning institutions will have to change their teaching methods, from those which position the teacher as a knowledge source to those which position him/her as a facilitator of the learning process, who will also respond to the learning technologies.

3.7 Availability of microcomputers as information retrieval tools in schools in South Africa

If microcomputers offer such educational opportunities as discussed in the various sections of this chapter, their availability at schools should be the concern of the highest authority of any nation. In the United States of America, NetDay[25] Home page carried a message from President Clinton and Vice President Gore, calling on parents, teachers, business people, and volunteers to help connect at least one classroom, media centre or library to the Internet. Silva (1995:244) reported that the interconnection of all sectors of the United States society: business, education, research, government, the public schools and libraries are explicitly legislated. Canada, on the other hand, has not enacted legislation to that effect, but has relied on federal initiatives, provincial projects, or private efforts. The result of the Canadian approach, according to Silva (1995:245), is that there was far less equitable distribution than was found in the United States. In Australia, Clyde (1995:26) wrote that the then Prime Minister Paul Keating had stressed the importance of the Internet. In South Africa, the Deputy President, Thabo Mbeki (1996:37) stated that technology-enhanced learning can make education more interesting and targeted on the individual. He added that the Internet and the WWW in particular "offered an immediate and inexpensive opportunity for schools". He acknowledged, however, that South Africa has a very skewed information infrastructure, which is very advanced in the cities, but totally lacking in large areas.

[25]NetDay is a day set aside by the United States Government for appeal for voluntary connections of schools, media centres and classrooms to the Internet. Internet address is http://www.netday.org.

The NEPI report (1992:31) noted the proliferation of 18 educational departments in South Africa under the previous political dispensation which were mana-ged and financed by 18 different ministries. It noted further that the majority of schools in some of the previous ministries were under-resourced. This resulted in gross discrepancies and inequity in provisioning of resources, and hence a backlog in the South African education system in terms of resources including IT. A catalogue of some of these backlogs (NEPI 1992; NCHE 1996; Radebe 1997) suggests that computers do not feature as a factor in education in South Africa. School buildings, school libraries, electricity, telephone and retraining of teachers need to be addressed first.

Information was presented from a University of Natal lecture on computers in schools in KwaZulu-Natal by Mossom (1986), who was then Senior Subject Advisor, Computer Education, and in charge of computer studies at the Natal Education Department (NED). He said that:

> all high schools under the control of the Natal Education Department had a computer room with at least 11 computers with software supplied by the Department, and some had bought additional computers from their own funds;
> at least half of the primary schools had purchased their own computers and software;
> all standard 6 and 7 pupils had formal computer literacy lessons;
> computer studies were available at the fourth phase (these are the last three standards in the NED; standards 8, 9 and 10) as an optional seventh subject in every NED school;
> computer literacy was being offered to teachers in the field, and those in training.

The presence of adequate infrastructure and logistics in schools is also conditional to the availability and use of the microcomputer and the Internet. The critical ones included: a school computer laboratory; a school library; electricity and telephone, as well as security for the safe-keeping of the expensive computers. A recent survey of Internet access was carried out in April 1998 by Marquard (1998:1) and the results are available in Table 1.

Table 1 Total number of schools in South Africa, number of schools with libraries, telephones, electricity and Internet access[26].

PROVINCE	TOTAL NUMBER OF SCHOOLS	NUMBER WITH LIBRARIES	NUMBER WITH TELEPHONES	NUMBER WITH ELECTRICITY	INTERNET
Eastern Cape	5880	433	1090	1351	90
Free State	2881	341	723	1226	12
Gauteng	2233	983	1883	1937	119
KwaZulu-Natal	5409	955	1840	2079	51
Mpumalanga	1907	290	702	975	6
Northern Cape	526	175	398	526	3
Northern Province	4170	205	1285	884	-
North West	2412	340	860	1082	1
Western Cape	1770	916	1547	1568	201
Not Verified	NIL	NIL	194	168	29
Total	**27188**	**4638**	**10422**	**11216**	**512**

Source: Bot (1997:1,3&4) and Marquard (1998)

Few schools have library facilities in South Africa, as observed in Table 1. Bot (1997:3) noted that there are wide variations between the provinces with regards to provision. The Eastern Cape and the Northern Cape schools have only 7% and 3% library provision, respectively, compared with 44% and 52% provision in Gauteng and the Western Cape, respectively. Bot (1997:1) indicated further that the majority of schools in the country do not have access to telephones on site. Three provinces, the Western Cape, Gauteng and Northern Cape have large proportions (87%, 84% and 76%, respectively) of schools with telephones. The Eastern Cape and the Free State, with 19% and 25%, respectively, are worst off in terms of telephone provision.

[26]Internet access data compiled by Marquard (1998) is superimposed on data of total number of schools, libraries, telephones and number with electricity, compiled by Bot (1997).

With regards to electricity, she reported that only 43% of schools have some source of electricity, while 52% are not even wired and 5% are wired with no connection. Lack of electricity, she noted, applied to almost three-quarters of schools in the Eastern Cape and 69% in the Northern Province. Only one out of ten schools in Gauteng and the Western Cape, on the other hand, are not wired.

The information in Table 1 is supported by the SAIDE Report (1998:36) which stated:

> ... only 43% of schools have electricity and only around 38% have telephones. Further, it estimated that 82 percent of schools have no media equipment, 72% no media collections, 73 percent, no learning equipment, and 69 percent no materials.

The report concluded that programmes seeking to exploit and implement [information and communication technology (ICT)] computer educational projects are likely to be of marginal or no value unless they are explicitly located within strategies to broaden meaningful access to the technologies themselves.

Table 2 Number of schools in KwaZulu-Natal, number and percentage with access to school libraries, telephones, electricity and Internet, and number and percentage without such access

TOTAL NUMBER OF SCHOOLS IN KWAZULU-NATAL	FACILITIES IN SCHOOLS	NUMBER WITH ACCESS TO	PERCENTAGE WITH ACCESS TO	NUMBER WITH NO ACCESS TO	PERCENTAGE WITH NO ACCESS TO
5409	LIBRARIES	955	18	4454	82
	TELEPHONE	1840	34	3569	66
	ELECTRICITY	2079	38	3330	62
	INTERNET ACCESS	51	0.9	5358	99.1

Source: Information in Table 2 is extracted from Table 1

A close observation of resource provision in schools in KwaZulu-Natal in Table 1 is represented in Table 2. It reveals that as many as 4454 (82%) schools in the province had no school libraries, and as many as 3569 (66%) schools had no telephone. The table showed that only 2079 (38%) out of 5409 schools had electricity and only 51 (0.9%) out of 5409 schools had Internet access. Due to the history of education and education resource provision in South Africa, as indicated by the NEPI (1992a and 1992b) Reports, among others, and Mossom's (1986) report on computers, it is probable that it was the previously advantaged schools that have most of the resources indicated above.

Neuman (1990:158) indicated that it has become a truism that wealthy schools own more computers than impoverished ones, and such schools augment their computers so rapidly that the gap between rich and poor schools is widening rather than shrinking. He noted further that when computers were introduced into suburban schools, it was often in the context of computer programming and computer awareness courses. In less affluent, rural areas, computer use was more likely to be in the context of computer-assisted instruction of the drill and practice variety. Affluent students were thus learning to tell the computers what to do while less affluent students were learning what the computer tells them to do. Neuman (1990:159) pointed out that technological inequity, as suggested by history, appears early and endures indefinitely. He predicted that the serious issues of equity occasioned by the microcomputer would become more critical and subtle as more and more powerful and sophisticated tools relating to the microcomputer appeared in the schools. Although writing in the American context, this has implications for the South African context, not only for computers but other information resources for education. For example, with regards to the provision of school libraries, in spite of recent acknowledgements of their role and importance in the implementation of the proposed Outcome Based Education (OBE) (ANC 1994; Isaacman 1996), little is happening on a practical level in the area of school library provision (Radebe 1997:22).

All hope does not seem lost with regards to availability of microcomputers and Internet connections to schools. Carroll (1998:1) reported that "the National Department of Education has embarked on a national initiative to network all the country's some 28 000 schools". SchoolsNET SA concedes that some of the country's better financed schools were already on-line and the Department was currently assisting disadvantaged ones in rural and urban areas. The initiative sought to address other computer education related issues such as: connecting all schools via the Internet (this entailed wiring all the schools), content development, teacher development and training, and promoting the Internet and computer training to support teaching practices in especially the previously disadvantaged schools.

Neuman (1990:159) also argued that a number of factors had conspired to place the school library media centre and its professional staff in the ideal position to meet the challenges posed by the implementation of new technologies in educational settings. He noted that, in the United States, the Association for Educational Communications and Technology (AECT) and The American Association of School Librarians (AASL) played a prominent role in the development of the American Library Association (ALA) Presidential Committee's Statement on Information Literacy which addressed the importance of technology in an information age school. It is therefore evident that South Africa is a long way off in effectively using microcomputers for information retrieval in a majority of its schools, especially the disadvantaged ones.

3.8 Summary

Chapter Three presents a review of the literature on information retrieval from the microcomputer for use in education. The Internet was emphasised as it was the thrust of information retrieval for the greater Pietermaritzburg Schools' Water Audit projects. Issues relating to information retrieval from microcomputers were discussed, as well as skills required for information retrieval and for information use. School projects involving the use of microcomputers were examined. The availability of microcomputers and related infrastructure and logistics in schools in South Africa were discussed.

Chapter Four
Research Methodology

4.1 Introduction

This chapter describes the research method employed in the study, including the literature search and review, the data collection instrument, research population and sampling.

4.2 Research methods employed in the study

4.2.1 The literature search and review

The literature search is an important component of research conducted in the social sciences. According to Aitchison (1998:58), the literature search enables the researcher to find out what has been done in relation to the problem being investigated so as to ensure that no duplication exists. It also brings about important understandings and insights necessary for the development of a logical framework (Gay 1976:24).

Because of the exploratory nature of the study, an extensive search of international literature in English was conducted, to collect information about:

> microcomputers as information retrieval tools in education;
> the Internet and the World Wide Web as information resources in education;
> issues relating to information retrieval from microcomputer systems;
> the use of microcomputers for school information retrieval projects;
> availability of microcomputers and related resources for information retrieval in South Africa and in KwaZulu-Natal.

4.2.2 The survey method

The descriptive survey was chosen because it sought to gain insight into a phenomenon [use of microcomputers as information retrieval tools in schools' Water Audit projects], as a means of providing basic information in that area of study (Bless and Higson Smith 1995:42).

4.2.2.1 *Ex-post facto*

At a broader level, the present study could be described as an *ex-post facto* study because it sought to analyse what had happened in the past (Busha and Harter 1980:43). *Ex-post facto* is essentially a descriptive research method. Leedy (1997:189) explained that an *ex-post facto* design belongs to the broad heading of non-experimental quantitative research. Leedy (1993:306) pointed out earlier that this design has been used with success in many research projects, though the design had been criticised in the literature for its lack of control (Busha and Harter 1981:43). Since the present researcher had no control over events that had already occurred, he could not be sure of what factors were involved, and it was not possible to be sure how many different circumstances might have influenced those events (Powell 1991:133). For example whether teachers' strike which was rampant in 1997 had an effect on the Water Audit projects.

4.3 Data collection

Two self-administered questionnaires were used in the study. One questionnaire was for the teachers/co-ordinators[27] of the Water Audit projects at the schools (as in Appendix 2) and the other for pupils who participated in the projects (Appendix 4).

[27]Co-ordinator in this sense is another name used for teachers in the various schools who were not necessarily classroom environmental teachers but were co-ordinators of schools' environmental clubs.

Two questionnaires were employed because the study sought to elicit views from both the teacher/school project co-ordinators' perspective and that of the pupils with regard to the role of the microcomputer as an information retrieval tool. Since questionnaires are one of the best impersonal observations used for eliciting data (Leedy 1993:187), there was more likelihood that respondents would be given the opportunity to respond honestly because of anonymity. Questionnaires were also used because it was not possible for the researcher to interview all 30 teachers/ co-ordinators, and 20% of pupils in each of the schools covered in the research population. A further reason for using questionnaires was that as the schools were scattered over the greater Pietermaritzburg area, financial[28] and time constraints would not allow for interviews to be used as a data collection technique. Questionnaires were delivered by the researcher rather than being mailed. The advantage in this regard was that the researcher was sure of a positive outcome of delivery[29].

4.3.1 Format of questionnaire

The questionnaires were semi-structured, comprising a mixture of closed and open ended questions. The questions were straight forward and therefore considered relatively easy to be answered by teachers and primary and secondary school pupils. Ex-DET primary schools used for the study were senior primary schools. Where the English language was considered a problem, pupils were guided by teachers in the presence of the researcher. The open ended questions were allowed for teachers and pupils to express their views as freely as possible on the issues under consideration. The generic name *computer* was used in the questionnaire instead of *the microcomputer*. This was because it was felt that not every pupil or teacher was conversant with the term microcomputer or types of computers and their names.

---

[28]The present research was not covered by any funding.

[29]It also gave the researcher the opportunity to gain a first-hand impression of the state of information resource provision such as libraries and computer laboratories at the various schools that were surveyed.

Questionnaires are designed to fulfil specific objectives (Leedy 1997:192) and the questionnaires for this study were designed to fulfil the objectives listed in Chapter One. An overview of the questions asked is provided below.

> teachers/co-ordinators' questions 1-7 sought to elicit background information from the various schools on: name, location, information resources present in the school, environmental education as part of the curriculum, class or project-based projects, and classes involved in the projects;
> teachers/co-ordinators question 8-16 focused on availability of computers in the schools;
> pupils' questions 1-5 dealt with the extent of use of computers *vis a vis* hard copy sources. Likewise teacher's/co-ordinators' questions 17-19;
> pupils' question 6 dealt with the usefulness of computer sources *vis a vis* hard copy sources;
> pupils' questions 7-12 dealt with skills acquired through training for the effective use of computers generally and also specifically for the Water Audit projects;
> pupils' questions 12-18 dealt with access to computers and assistance in using computers;
> pupils' questions 19-20, as well as teachers' questions 20-25, focused on problems experienced in the use of computers during the projects;
> teachers' question 26 dealt with the impact of computers on the projects, while
> teachers' questions 27 and pupils' questions 21 and 22 elicited suggestions on how to improve future projects using computers.

The questions were designed in such a way that in many instances they provided respondents with an opportunity of indicating their views only up to the extent of their participation in the Water Audit projects. The reason was that it was assumed that not all schools had the opportunity to use computers for information retrieval. Even if the schools had the opportunity, certain unanticipated problems might have made it impossible to use the computers.

The questionnaires were accompanied by covering letters (as in Appendices 1 and 3). They consisted of 27 questions for the teachers/co-ordinators and 22 for the pupils (as in Appendices 2 and 4).

4.3.2 Pre-test for validity and reliability

The questionnaires were pre-tested on 3 of the schools and 10 pupils who participated in the projects. The purpose was to test the instruments for validity and reliability (Newell 1993:99). The importance of scrutinising the data gathering instruments to identify ambivalent or misleading questions and instructions and suggest improvements was emphasised by Gay (1976:131) and Newell (1993:112). Minor changes were made in collaboration with the supervisors of the study.

4.4 Research population

The research population is considered a critical part of any survey, especially a descriptive one. As observed by Leedy (1993:197-198), nothing comes out at the end of a long and involved study that was any better than the care, precision, consideration and the thought that went into the basic planning of the research, and the careful selection of the population. The research population of this study was defined as teachers/school project co-ordinators and pupils in primary and high schools in the greater Pietermaritzburg area who participated in the 1997 Water Audit projects. The names of the 40 schools which participated in the projects were provided by the project co-ordinators who helped in categorising the schools according to the previous education departments. The schools were from the ex-Natal Education Department (NED) schools, ex-Department of Education and Training (DET) schools, ex-Department of Education and Culture (House of Delegates) schools and the private or independent schools.

4.4.1 Sampling

Thirty schools were chosen from the total of 40 on the basis of their accessibility to the researcher as the researcher was unable to move into some of the schools that were considered "out of route"[30]. The sampling method used in this regard can be described as purposive sampling. This is:

> ...described as judgemental (also referred to by Bailey (1982:99) as purposive) sampling. Burges states that "In judgemental sampling informants may be selected according to a number of criteria established by the researcher such as their status (age, sex and occupation) or previous experience that endows them with special knowledge" (Leach 1991:189).

The targets at the various schools for this study were teachers or school environmental co-ordinators who used their classes or clubs to organise the Water Audit projects in the various schools, and pupils who took part in the projects. Thirty teachers in all comprised the final sample of which 24 responded to the questionnaire. Three did not respond and the remaining three were used for the pre-test. Twenty percent of the pupils who participated in the projects, that is 110 out of 550 comprised the second sample. The number of pupils sampled in each school is indicated in brackets attached to the participating schools in Appendix 5. Class levels were not considered important as almost all participating schools in the ex-DET were club based.

4.5 Data analysis

Manual analysis was used to analyse the quantitative following a recommendation by Fox (in Seaman 1987:336). The data in each category was counted and manually indicated in the form of tables. In the present study absolute numbers and corresponding percentages were used to express proportions. As noted earlier,

---

[30]"Out of route" is used in this context to mean remote settlements where the researcher could not commute to for lack of personal transport at the time of the survey. Local taxis used to administer the questionnaires seldom plied these routes.

tables were used to present most of the findings. Content analysis, described as a method of analysing qualitative data (Saunders and Pinhey 1983:185), was used for analysing responses to the open-ended questions. Gay (1976:137) describes this method as the systematic quantitative description of the composition of the object of the study. He distinguishes between simple content analysis involving frequency counts and more complex analysis that might be used to investigate bias in text. The former method was used in this study.

4.6 Summary

To gain information into the availability and use of microcomputers for the 1997 schools' Water Audit projects, two methods were used, namely a literature review on the one hand and a descriptive survey on the other. These are both presented in this chapter. The data collection instrument was described, as was the sampling and method of data analysis.

Chapter Five

Data Presentation and Analysis

5.1 Introduction

This chapter covers data presentation and analysis, based on objectives set for the study, as outlined in Chapter One. Findings from the two questionnaires, one for teachers/co-ordinators and one for pupils, are presented, starting with background data, followed by the findings related to the research questions. Those related to the teachers were dealt with first, followed by those relating to pupils. Tables are used to present some of the findings, many of which are categorised according to ex-education departments.

In all, 40 schools in Pietermaritzburg and the Natal Midlands were introduced to this researcher by the co-ordinators of the schools' Water Audit projects, as schools that participated in the projects. These schools are categorised according to their ex-departments of education. According to the NEPI Report (1992b:7) on governance and administration of education in pre-democratic South Africa, "education was fragmented into nineteen operating departments under fourteen different cabinet ministers implementing their own regulations". Four of these departments existed by law in the Natal Province. These were; the exclusive white Natal Education Department (NED); the only Indian House of Delegates (HOD) department; the coloured House of Representatives (HOR) department; and the department of education and training (DET) which was exclusive for black pupils in the mainland of the former South Africa. Schools covered in the study are located in the greater Pietermaritzburg area, as in Appendix 5. As was mentioned in the previous chapter, 30 schools were sampled out of a total of 40, and 24 responded.

5.2 Data from the teachers' instruments

The 24 schools that participated in the study were categorised according to their ex-departments of education in KwaZulu-Natal, as in Table 3.

Table 3 Categorisation of number of schools[31] according to ex-departments of education

EX-DEPARTMENT OF EDUCATION	NO OF SCHOOLS SURVEYED	% OF SCHOOLS SURVEYED
NATAL EDUCATION DEPARTMENT (NED)	6	25
DEPARTMENT OF EDUCATION AND TRAINING (DET)	11	46
HOUSE OF DELEGATES (HOD) INDIAN	2	8
INDEPENDENT (PRIVATE)	5	21
TOTAL	24	100

As can be seen in Table 3, the majority (46%) of schools in the study were ex-DET, followed by ex-NED (25%) and independent schools (21%). The least represented (8%) were from the ex-HOD. It is not surprising that the majority of schools studied were ex-DET schools. This is due to the purposeful sampling technique that was used.

Availability of information resources in the schools

Availability of resources (Table 4) include computer laboratories, school libraries with computers, school libraries with no computers and media teachers.

[31]Teachers' responses are categorised as schools on behalf of the schools.

Table 4 Availability of information resources

EX- DEPARTMENTS OF EDUCATION	INFORMATION RESOURCES					
	COMPUTER LABORATORY	SCHOOL LIBRARY WITH COMPUTER	SCHOOL LIBRARY NO COMPUTER	MEDIA TEACHER	NO RESO- URCES	NO OF SCHOOLS
NED	6	6	NIL	6	NIL	6
DET	NIL	NIL	6	1	5	11
HOD	2	NIL	2	2	NIL	2
INDEPENDENT	5	5	NIL	5	NIL	5

It is evident from Table 4 that all the ex-NED schools and independent schools had the resources while the least resourced are the ex-DET schools, where only six out of 11 schools had a library of whom only one had a media teacher, and five out of the 11 ex-DET schools had no information resources.

Environmental education as part of the curriculum

Table 5 Environmental education as part of the curriculum

EX-DEPARTMENT OF EDUCATION	ENVIRONMENTAL EDUCATION CURRICULUM BASED	ENVIRONMENTAL EDUCATION NOT CURRICULUM BASED
NED	5	1
DET	NIL	11
HOD	NIL	2
INDEPENDENT	5	NIL
TOTAL	10	14

Ten (five NED and five independent) schools indicated that environmental education was part of the curriculum, while 14 (11 DET; two HOD and one NED) schools indicated that it was not part of the curriculum. Findings also show (Table 5) that all the independent schools had, as part of the curriculum, environmental education, as did five out of the six ex-NED schools. None of the ex-DET and ex-HOD schools had environmental education as part of the curriculum.

Environmental education not part of the curriculum

Table 6 Projects categorised according to class or club

EX-DEPARTMENT OF EDUCATION	CLASS PROJECT	CLUB PROJECT
NED	5	1
DET	2	9
HOD	1	1
INDEPENDENT	4	1
TOTAL	12	12

It is apparent that in those schools which did not have curriculum-based environmental education (Table 5) the projects were club based. As reflected in Table 6, these applied mostly to the ex-DET schools.

Availability, use and problems of computers in relation to the Water Audit projects

Table 7 Availability of computers for information retrieval

EX-DEPARTMENT OF EDUCATION DEPARTMENT	NUMBER OF SCHOOLS	NUMBER WITH OWN COMPUTERS	NUMBER WITH LOANED COMPUTERS
NED	6	6	
DET	11		2
HOD	2	2	1
INDEPENDENT	5	5	

It is evident from Table 7 that all the six ex-NED and five independent schools had their own computers for information retrieval during the projects. Computers were loaned to the ex-HOD and ex-DET schools. It must be noted that the ex-HOD schools had computers at their computer laboratories as shown in Table 4. However, these computers were not used for the purpose of information retrieval for the projects because they were not functional for this purpose. Thus, while they did have computers of their own, these were not used for the Water Audit projects. One

of the ex-HOD schools received a loaned computer for the purpose of the project but this school, as well as one ex-DET school out of the two which received loaned computers, indicated that the computers were not functional during the project and were thus not used.

Duration of using computers for information retrieval

Table 8 Duration of ex-departments' use of computers

EX-DEPARTMENT OF EDUCATION	NUMBER OF SCHOOLS AND NUMBER OF YEARS USING COMPUTERS							
	LESS THAN 1 YEAR	2 YEARS	3 YEARS	4 YEARS	5 YEARS	8 YEARS	MORE THAN 8 YEARS	NUMBER OF SCHOOLS
NED					2	1	3	6
DET		1						1
HOD	1							1
INDEPENDENT					1	1	3	5

It is evident from Table 8 that the majority of Independent and NED schools had been using computers for information retrieval for over eight years. The DET school had been using computers for information retrieval for two years and the HOD school, for less than a year.

Why computers could not be loaned to certain schools

Four ex-DET rural schools indicated that they could not have computers loaned to them by the KwaZulu-Natal Nature Conservation Service because of infrastuctural problems, including lack of electricity, lack of telephone and lack of security.

Computers available in the departments during the Water Audit projects

Table 9 Total number of computers available for the projects

EX-DEPARTMENT OF EDUCATION	NO OF SCHOOLS WITH COMPUTERS	TOTAL NO OF COMPUTERS IN THE SCHOOLS
NED	6	45
DET	2	2
HOD	1	1
INDEPENDENT	5	100

The independent schools had the highest number of computers (100) available during the Water Audit projects, while the ex-DET and ex-HOD schools had one computer available in each school. It must be noted that the ex-HOD computer was non-functional for information retrieval during the projects.

Usage of resources

Of the 14 schools (as shown in Table 9) that indicated that computers were available during the Water Audit projects, four (29%) used the computers the most whilst 10 (71%) used hard copy sources the most. Hard copy sources, preferably periodicals, were used more for retrieving information during the projects. It must be noted that one ex-HOD and one ex-DET school did not use computers for the projects as these computers were not functional.

Table 10 Why one source was used more than the other

NUMBER OF SCHOOLS AND RESOURCES USED	REASONS FOR USING ONE SOURCE MORE THAN THE OTHER
4 (used hard copies more)	Because there was no need for computers
4 (used hard copies more)	Because problems were experienced with the computers
2 (used hard copies more)	Because of lack of communication with project co-ordinators
2 (used computers more)	Because computers had more information and were enjoyable to learn with
2 (used computers more)	Because pupils were able to share information on their projects

Three reasons were given by 10 schools that used hard copies more than computers, and two reasons were given by four schools that used computers more, as shown in Table 10.

Frequency of use of information resources

Table 11 Frequency of use of *Enviro-Facts* in different media

Frequency of use of Resource	Very often	Often	Not often	Not at all
Enviro-Facts on Internet	4	0	0	10
Enviro-Facts on diskette	2	2	4	6
Enviro-Facts on pamphlets	8	2	4	0

It is evident from Table 11 that *Enviro-Facts* on pamphlets had the highest frequency of use while *Enviro-Facts* on the Internet was the least used.

Problems concerning the use of computers during the projects

Of the 14 schools which had computers, only eight responded to this question. While **six indicated** that the **pupils experienced problems** using computers **two** said there were **no problems**.

Problems that were experienced

Of the six schools which reported problems two identified the **problem** of **congestion** which hampered the use of the computers; three indicated that the **pupils complained of inexperience with computers;** one school indicated **problems in communicating** findings of their projects with others, using the computer. All six respondents, namely one ex-DET one ex-HOD, two ex-NED and two independent schools, indicated that they were not able to solve these problems.

Effect of problems on the quality of the projects

Of the six schools that reported they had problems, five reported that **the problems affected the projects**. The effects of the problems are reflected in Table 12.

Table 12 Effect of computer problems on the projects

FREQUENCY OF RESPONSES	RESPONSES
4	Non-functional computers, inability to retrieve information
4	Inability to communicate pupils' project findings to others
3	Morale of the pupils had waned due to non-functional computers
2	Non-functional computers meant to pupils that projects had failed

Contribution of computers to projects

Of the 14 schools that had access to computers eight responded. All eight schools indicated that **computers did indeed contribute positively** to the projects.

How computers positively affected the projects

Table 13 Positive effect of computers on the projects

FREQUENCY OF RESPONSES	RESPONSES
4	The use of the Internet helped to share information and helped increase pupils' knowledge
4	The Internet provided more information
3	Pupils were able to store information on the computers at the project site and analyse this information later
3	Pupils took part keenly because of the presence of the computers

When asked how computers had positively affected the projects four responses were given in all. The responses of the eight schools in each case are indicated in Table 13.

Suggestions for the effective use of computers for environmental education

Table 14 Teachers' views for the improvement of future projects

FREQUENCY OF SUGGESTIONS	SUGGESTION
8	Future involvement of media teachers in computer projects
5	Internet access must be extended to as many schools as possible
5	More computers will contribute to enhancing computer literacy
5	Training workshops for teachers and pupils must be more extensive and detailed
3	Security must be improved to safeguard computers in schools
3	Technical computer training for teachers to attend to non-functional computers.
2	Provision of media centres and media teachers
2	The use of geographical information systems in future environmental education projects
2	School computer networks must be encouraged
1	Improvement upon electricity and telephone facilities

Ten teachers out of 14 schools which reported they had computers responded to this question. The frequency of suggestions range from 1 to 8. The suggestion of future involvement of media teachers in computer projects dominated in frequency suggestions. The suggestion of technical training of teachers and security prevailed mostly with the ex-DET schools.

5.3 Data from the pupils' questionnaire

Categorisation of pupils' participation in the Water Audit projects

The number of pupils that participated in the Water Audit projects is categorised according to the ex-departments of education as follows:

Table 15 Categorisation of number of pupils who participated in the Water Audit projects

EX-DEPARTMENT OF EDUCATION	NO OF PUPILS THAT PARTICIPATED IN PROJECTS	NUMBER OF PUPILS SURVEYED	PERCENTAGE OF TOTAL NUMBER OF PUPILS SURVEYED
NED	205	41	38
DET	115	23	21
HOD	40	8	7
INDEPENDENT	190	38	35
TOTAL	550	110	100

As is evident in Table 15, a total number of 550 pupils are reported to have participated in the Water Audit projects, and 20% of these were surveyed, resulting in 110 pupils. The bulk of the pupils surveyed (66%) were from the ex-NED and Independent schools. The minority of pupils were from the ex-HOD schools. The bulk of 41 pupils surveyed from six ex-NED schools is a contrast to 23 pupils from 11 ex-DET schools, as shown in Table 3. This is because five of the six ex-NED projects involved a whole class of about 35 pupils while almost all ex-DET schools had club based projects with pupils ranging from 5-20.

Usage of computers

Use of computers for information retrieval during the Water Audit projects

Of the 110 pupils surveyed, 33 (30%) indicated that they used computers for information retrieval during the Water Audit projects, while 77 did not use computers

for information retrieval. It is an obvious assumption that the 77 who did not use computers used instead, hard copy sources for the projects.

Table 16 Categorisation of pupils' use of computers

EX-DEPARTMENT OF EDUCATION	NUMBER OF PUPILS THAT USED COMPUTERS	PERCENTAGE THAT USED COMPUTERS	NUMBER OF PUPILS THAT DID NOT USE COMPUTERS	PERCENTAGE THAT DID NOT USE COMPUTERS
NED	13	39	28	36
DET	2	6	21	28
HOD	NIL	NIL	8	10
INDEPENDENT	18	55	20	26
TOTAL	33	100	77	100

The vast majority of pupils who used computers for information retrieval for the Water Audit projects were from ex-NED and from independent schools.

Table 17 Pupils' access to and use of computers for information retrieval

EX-DEPARTMENT OF EDUCATION	NO OF PUPILS	ACCESS TO COMPUTERS	NO ACCESS TO COMPUTERS	ACCESS TO COMPUTERS BUT DID NOT USE THEM
NED	41	41	NIL	28
DET	23	2	21	
HOD	8	-	8	
INDEPENDENT	38	38	NIL	20
TOTAL	110	81	29	48

Of the 110 pupils surveyed 81 (41 NED; 2 DET and 38 Independent) had access to computers, while 29 (21 DET and 8 HOD) did not have access to computers, leaving 48 (28 NED and 20 Independent) who had access but did not make use of computers.

Why computers were not used for information retrieval

Table 18 Pupils' reasons for non-use of computers

N=48

RESPONSES	NO OF RESPONSES	% RESPONSE
No access to computers	31	65
Non functional computers	28	58
No access to Internet	25	52
Teachers felt projects were not computer use related	20	42
Poor communication with project co-ordinators	16	33

Five reasons were provided by the 48 pupils who had access but did not use computers (Table 17), as to why computers were not used for information retrieval. The predominant reason, given by 31 (65%), were no access to computers, followed by 28 (58%) of non-functional computers. These include the eight ex-HOD pupils. The least-mentioned reason, given by 16 (33%) of the pupils was poor communication with project co-ordinators.

Usage of hard copy sources (books, pamphlets, etc.) for information retrieval

All 110 pupils surveyed **responded** that **they used hard copy sources** for information retrieval during the Water Audit projects.

Source used more often, hard copy or computer

As to which source was used more often (hard copy or computer), 30 (37%) pupils responded that they used computers more, while 51 (63%) out of 81 pupils that had access to computers (see Table 17) indicated that they used hard copies more than computers. When one considers that 33 pupils used computers and 30 used computers more, it is evident that three pupils who used computers actually used hard copies more than computers.

Reasons for using computers more than hard copies

Table 19 Pupils' reasons for using computers more than hard copies

N=30

PUPILS' RESPONSES	NO OF RESPONSES	PERCENTAGE RESPONSE
It takes less effort to retrieve information	20	67
It was enjoyable to work and learn with computers	18	60
It enabled pupils to communicate their findings with others and learn from them	8	27
It was the easiest means of writing and storing information	4	13

Thirty pupils responded to this question. Four responses were provided as to why computers were used more than hard copies. The majority 20 (67%) responded that it took less effort to retrieve information. Four (13%) indicated that it was the easiest means of writing and storing information.

Reasons for the use of hard copies more than computers

Table 20 Reasons for the use of hard copies (books, pamphlets, etc.) more than computers

N=51

PUPILS' RESPONSES	NO OF RESPONSES	PERCENTAGE RESPONSE
Sources used were what the teachers provided	39	76
All relevant instruction was available in project buckets	35	69
Those are the sources pupils were used to	25	49
Pupils did not need computers.	16	31

Fifty-one pupils (many who had access to computers) responded to this question. The majority of pupils (39 or 76%) used hard copies more than computers because those were the sources provided by their teachers. Thirty-five (69%) used hard copy sources because the project buckets contained relevant information for the projects. The least (16, or 31%) used hard copies more than computers because they felt they did not need computers.

Frequency of use of information sources

Table 21 Frequency of use of information resources by pupils

INFORMATION RESOURCE	VERY OFTEN		OFTEN		NOT OFTEN		NOT USED		TOTAL	
	NO	%	NO	%	NO	%	NO	%	NO	%
Enviro-Facts on Internet	11	10	5	4	6	6	88	80	110	100
Enviro-Facts Diskette	11	10	15	14	7	6	77	70	110	100
Enviro-Facts on pamphlets	66	60	22	20	22	20	0	0	110	100

Table 21 above shows that 22 (67%) of the 33 pupils who used the computer used the Internet. It is also observed that 33 (30%) of 110 pupils used computers to retrieve information from the *Enviro-Facts* diskette, while 77 (70%) did not. All 110 (100%) pupils surveyed used *Enviro-Facts* on pamphlets to retrieve information.

Information resource that was found more useful

Table 22 Useful information resources

INFORMATION RESOURCES	VERY USEFUL		USEFUL		LESS USEFUL		NOT USED		TOTAL	
	NO	%	NO	%	NO	%	NO	%	NO	%
Enviro-Facts on Internet	13	12	3	3	6	5	88	80	110	100
Enviro-Facts on diskette	18	17	8	7	7	6	77	70	110	100
Enviro-Facts on pamphlets	59	54	26	24	25	22	0	0	110	100

It is evident from Table 22 that the usefulness of the Internet and *Enviro-Facts* on diskette is realised when one takes into account that 16 out of 22 (73%) pupils who used the Internet found it very useful or useful, and 26 out of 33 (79%) pupils found the *Enviro-Facts* database on disk very useful or useful. Results also show that 85 pupils out of 110 (78%) who used *Enviro-Facts* on pamphlets (hard copies), found it useful.

Training acquired prior to using a computer for information retrieval

Of the total 110 respondents, 40 (36%) responded (to question 8) that they had acquired training prior to using computers for information retrieval. A summary of their responses is presented in Table 23.

Table 23 Training acquired prior to using computers for information retrieval

N=40

TYPE OF TRAINING	NUMBER OF RESPONSES
Computer awareness	30
Keyboard skills	28
Information skills	23

Even though 40 pupils responded that they were trained, the number of responses is large because of multiple answers provided. It was obvious from Table 23 that there was more computer awareness training (30) than other kinds of training.

Adequacy of training

Fifteen out of 40 (38%) pupils who received training responded that they had received adequate training, while 25 (62%) responded that the training was not adequate.

Reasons for inadequate training

Twelve out of 25 (48%) respondents who had no adequate training pointed out that the training had lasted a few hours. Eight (32%) responded that their teachers were not good at computers. The rest (five, or 20%), said that there was only one computer and they had no opportunity to practise.

Training and adequacy of training acquired prior to the Water Audit projects

Table 24 Training acquired prior to the Water Audit projects

N=60

TYPE OF TRAINING	NUMBER OF RESPONSES	% RESPONSE
Computer information retrieval skills	40	67
Computer awareness	30	50
Information skills	25	41
Keyboard skills	23	38

Sixty pupils responded that they received training specifically prior to the Water Audit projects. Table 24 reveals that the majority of pupils (40 or 67%) were trained in computer information retrieval skills while the minority were trained in keyboard skills.

Adequacy of training for the Water Audit projects

Forty-five pupils (75%) who received training specifically prior to the Water Audit projects responded that the training received was not adequate.

Reasons for inadequate training

The reasons for inadequacy of training were: the majority (40 or 67%) responded that the training lasted for only one day, and there was no follow-up from their teachers. The rest (20 or 33%) responded that they had no opportunity to practise what they had learnt.

Sufficiency of time using the computer as a source of information retrieval

Twenty five (76%) of the 33 pupils that used computers for information retrieval during the Water Audit projects said that they did not have sufficient time to use the computer as a source of information.

Reasons for insufficient time to use the computer

Of the 25 pupils who said there was not sufficient time to use the computers for information retrieval their responses were as follows: Ten (40%) responded that they could not use the computers themselves. Eight (32%) responded that there was a limited number of computers, six (24%) had problems with the Internet and one (4%) responded that the computers were not stationed in their schools. It must be noted that the computer that was in use at the DET school was taken away at the end of use daily due to problems with security.

Help with computer usage

Twenty of the 33 (61%) pupils that used computers for information retrieval indicated that there was someone to help with information retrieval, while the remaining 13 (39%) said there was no one to help. Five (39%) of the 13 pupils who did not receive help indicated that the school librarian did not seem interested in what they were doing.

Satisfaction with the help offered during the use of computers

Of the 20 pupils that indicated that there was someone to help with computer information retrieval, 10 (50%) indicated that they were satisfied with the help offered. Five (50%) of the pupils who said they were not satisfied with the help gave their reasons as not being able to retrieve information effectively on their own after the help they had was gone. The other 5 (50%) indicated that the help was short-lived and not adequate because their teacher was not good at computers.

Problems experienced

Of the 33 pupils that used computers for information retrieval 20 (61%) indicated that they had experienced problems, while 13 (39%) indicated that they did not have other problems. The responses are presented in Table 25.

Table 25 Problems encountered in the use of computers

N=20

PUPILS' RESPONSE	NUMBER OF RESPONSES	PERCENTAGE RESPONSE
Difficulty in locating relevant information on the Internet	10	50
Intermittent functioning and irregular availability of computers	8	40
Time wasted on non-relevant information	6	30
Too much information to sort out relevant ones	6	30
Inability to communicate sometimes with the Internet	5	25

Twenty pupils responded to this question. The majority (10 or 50%) responded that difficulty in locating relevant information was a problem, while the least-mentioned problem (5 or 25%) was the inability to communicate using the Internet.

Suggestions to how the computer could help better as an information resource for Environmental Education

Of the 81 pupils who had access to computers 50 responded to this question. The majority of pupils (30) suggested the need for more computers for information retrieval and communication of project findings. Eighteen suggested the need for improved training to access relevant material. Fifteen suggested the need for training of teachers and librarians while 10 indicated the need for encouraging schools network projects. The least number (5) suggested the need for school Web pages to store information.

Chapter Six
Discussion of results

6.1 Introduction

The discussion of results is based on the objectives set for this study as outlined in Chapter One. Each objective is discussed in relation to the results of the survey and available literature. The role of the media teacher is also discussed.

6.2 Availability of microcomputers as information retrieval tools

The objective in this instance was to provide information on the extent to which schools that participated in the Water Audit projects were equipped with microcomputers. It was evident from the findings of the study that there was unequal provision of microcomputers as information retrieval sources between the previously advantaged and disadvantaged schools. While, for example, all six ex-NED and five Independent schools had microcomputers for information retrieval in their school libraries (Tables 4 and 7), and some were connected to the Internet in their computer laboratories, none of the 11 ex-DET schools surveyed had computers of their own for information retrieval. Although the two ex-HOD schools had computers in their computer laboratories, these were not used, as they were not functional for the projects. The point of unequal provision is confirmed by further findings (Table 9) of the number of computers available during the projects in the schools. The duration of schools' use of computers for information retrieval (Table 8) further explains the inequality of provision of computers between the advantaged and disadvantaged schools. The situation of unavailability of information resources in certain department schools is further illustrated by the fact that, while all ex-NED and all independent schools had school libraries, computer laboratories and media

teachers (Table 4), five out of the 11 ex-DET schools had no information resources of any kind. No ex-DET school had a computer laboratory, only one had a media teacher and only six out of the 11 ex-DET schools had libraries. The two ex-HOD schools had computer laboratories which were not functional for the projects, school libraries without computers and both had a media teacher each. School libraries in the ex-DET schools, as observed by the present researcher, were in most cases a collection of textbooks which should have been in the bookstore. No meaningful information retrieval system existed in such schools and no meaningful information retrieval seemed to be taking place in the libraries by either pupils or teachers.

The results of this survey correspond with the point made by Neuman (1990:159), that technological inequality appears early and tends to endure indefinitely. Unless this situation is addressed soon, the state of provision of microcomputer systems in the previously disadvantaged schools will again correspond with Neuman's (1990:160) prediction that serious issues of equity, occasioned by the microcomputer, will become more critical and subtle as more sophisticated tools relating to the microcomputer appear in schools. He warned that the advent of the emerging technologies will signal an unbridgeable gulf between those who are in society's mainstream and those who, for whatever reason are in the eddies. There is also a real danger that by unequal access to information tools and information the formation of a new class of *top dogs* and *underdogs* which was predicted by Rodda (1998:1) is strongly possible. Rodda (1998) observed that it was the rural people who are in most danger of becoming the *digital underdogs* in South Africa. In the same vein, Eco (1996:3) agreed with Neuman (1990:160) that "society will be divided into classes where the haves of information technology will be afforded the opportunity of analysing and distinguishing between news and babble, creating a situation reminiscent of George Orwell's 1984". In this study for example it was observed that the disadvantaged schools were deprived, to a large extent, of knowledge which should have been gained from electronic information exchange through the Internet. The use of microcomputers by only 2 (6%) (Table 16) previously disadvantaged pupils in this study is an indication of the denial of the

majority of South African pupils of the use of this resource which, according to Welch *et al.* (1996), Mbeki (1996), Todd (1997) and Carvin (1998), among others, is becoming an indispensable educational tool.

Findings also revealed that during the Water Audit projects only two of the ex-DET and one ex-HOD school had computers lent to them by the KwaZulu-Natal Nature Conservation Service. The computers loaned to one of the ex-DET schools and one ex-HOD school did not function due to inadequate infrastructure and logistics, and the functional computer at the ex-DET school was not available regularly for information retrieval, due to lack of adequate infrastructure and security. In terms of findings of the present study, many rural schools had not been able to accept microcomputers for the projects simply because they lacked the necessary infrastructure and also experienced logistical problems.

It should, however, be pointed out that, though important, the microcomputer is not the limiting factor to delivery of education in the previously disadvantaged communities in the greater Pietermaritzburg area and for that matter in South Africa. As revealed by this study, the critical limiting factors were school buildings, lack of school libraries, lack of electricity and lack of telephones as indicated in Table 1 and corroborated by the SAIDE Report (1998). These issues needed to be addressed first. Rodda (1998:2) estimated that 75% of the 30 000 schools in South Africa did not have telephones, and as Telkom was the only company currently attempting to meet this huge demand, it was unlikely that the situation would change in the short to medium term. It was also evident from the information provided by Bot (1997) and Marquard (1998) in Table 1 and confirmed by the SAIDE Report (1998), that the lack of computers was one lack among others, which related mostly to the disadvantaged communities of South Africa. The data in Table 2 relating to KwaZulu-Natal represented a skewed state of provision in relation to the previously advantaged and disadvantaged schools in the province (Mossom 1986; Rodda 1998).

The conclusion, therefore, was that due to the lack of infrastructure and logistical problems microcomputers were not able to play a major role as providers of

information during the Water Audit projects. Communication of project findings were also hampered, as well as speedy retrieval of information. Therefore the loaning of computers by the KwaZulu-Natal Nature Conservation Service though laudable did not achieve the objective of the use of microcomputers by previously disadvantaged schools. For microcomputers to benefit their users the infrastructure has to be adequate. This is not the case in South Africa due to the infrastructural backlog, as presented in Table 1 and confirmed by the SAIDE Report (1998).

6.3 The extent of use of microcomputers as information retrieval tools *vis a vis* hard copy sources

This objective sought to establish the extent of use of microcomputers *vis a vis* hard copy sources in participating schools that owned computers and those with computers loaned to them. This study found that not only did a limited number of four (29%) out of 14 schools that had computers use computers more than hard copy sources, as reported by teachers on usage of resources, but only 33 (30%) out of 110 pupils used computers (Table 16). The vast majority 31 (94%) (Tables 16 and 17) were from the ex-NED and independent schools which owned computers. Only two (6%) pupils from previously disadvantaged ex-DET schools who had access to loaned computers actually used the computers. The extent of use of hard copies, on the other hand, was high (Table 16) with all the departments. There was consensus among teachers and pupils as to why one source was used more than the other (Tables 10, 18, 19 and 20). Teachers and pupils felt that computers had more information, were enjoyable to work with and served as a means of communicating project findings. Both teachers and pupils felt, however, that hard copies were used because they were what was available, the projects were not computer related, and there were problems experienced with computers. The reasons for the use of hard copies seem to suggest that computers would have been used more if they had been available devoid of problems. However, Table 17 shows that as many as 28 (68%) pupils who had access to computers in the ex-NED did not use them. And

more than half of pupils from independent schools did not use computers, even though they had access. Overall, 51 (63%) out of 81 pupils who had access to computers used hard copies more than computers and three pupils who used computers for information retrieval still used hard copies more for information retrieval. This indicates that hard copies were still preferred where computers existed for information retrieval.

The predominant use of hard copy sources is probably explained by the fact that the ex-NED and the independent schools had libraries where pupils used hard copies sources, and only used electronic sources to complement their information. The ex-DET school that used the computer in this study, for instance, did not have a school library. A further factor that could explain the dominant use of hard copies (Table 21) was that the project buckets had an information package, which all schools had to use, accompanying the project. Hard copy sources had also traditionally served as information retrieval sources in schools. Thirty-eight (35%) out of 110 pupils (Table 20), for example, responded that such sources were what their teachers provided for their use, and 25 (22%) out of 110 pupils indicated they were used to utilising such resources.

The use of electronic information sources more especially the Internet, as a complement to hard copies from the school library, was emphasised by a number of writers such as Herring (1996), Kafai and Bates (1997) and the SAIDE Report (1998). The reason for emphasising electronic sources as a supplement to hard copies was due to the inadequacy of information from the Internet (Herring 1996:21). In the SNAP Dragon Internet project, reported in the literature review, Kafai and Bates (1997:103) indicated that students used the WWW for finding more information in addition to reading from their textbooks or consulting in the library media centre. The SAIDE Report (1998) also pointed out that the Internet could simply be used as an additional source of information, or as an extension of the library. It was evident from this study, therefore, that hard copy sources such as periodicals, books, etc. from the school library or media centre, are information resources that cannot not be dispensed with during schools information retrieval

projects. The extensive use of hard copy sources by the advantaged schools in spite of the relative abundance of computers, was evidence of this. The Internet and other electronic databases are an extension of the library and hard copy sources. This disputes the suggestion that electronic sources are replacing the book as indicated by Lancaster (1977), Irving (1988), Kurzweil (1992) and Welch *et al.* (1996).

6.4 Usefulness of microcomputers *vis a vis* hard copy sources

This objective sought to find out how useful microcomputers were as information retrieval sources *vis a vis* hard copy sources during the projects. The study found that 26 (79%) out of the 33 pupils who used the microcomputer system found the resource **very useful or useful**. Similarly, 16 (73%) out of 22 who used the Internet found it very **useful or useful** (Table 22). The findings are consistent with available literature which emphasised the usefulness of computers and the Internet as information retrieval and communication resources for education. Mossom's (1986) experience with pupils' enjoyment of studies with computers, the report by Clyde (1995:26) on the recent growth of the Internet in schools in Australia, the research findings reported by Todd (1997:12) on students with on-line access, the SAIDE Report (1998) and Carvin (1998) quoted earlier in the literature review, among others, are some of the examples that the findings of this study support.

Pupils' varied reasons given for preference of microcomputers to hard copy sources (Table 19) are indications of how computers could serve not only as useful information retrieval tools for environmental education but in all subjects across the curriculum. Without this resource, writers such as Mossom (1986), Olën (1989), Johnson (1995), Campbell (1996), Mbeki (1996), Todd (1997) and Carvin (1998), among others, argued that not only would pupils not find learning enjoyable, but they would not be able to play a meaningful role in today's society. Weinberger (1997:624-625), writing on 21st Century literacy, noted that thinking skills, classified

as the ability to acquire and evaluate information, organise, interpret and communicate using computers, were critical in the American labour market. He argued that since technology which advanced rapidly made obsolete much of the information imparted to pupils over their course of formal learning, students needed to experience a passion to learn and a reward for seeking which could only be offered by the digital library. Not-withstanding the usefulness of microcomputers as expressed by pupils, the majority (88 or 80%) out of 110 that used hard copies (Table 22) indicated that they found them either very useful or useful. It was therefore conclusive that hard copy sources are still very useful sources for information retrieval in computer information retrieval projects.

6.5 Extent of pupils' training to enable them to retrieve and use information

This part of the study sought to establish the skills pupils had acquired from the training that they had received prior to using computers, generally, and prior to using computers for the Water Audit projects in particular. The study found that **some training was acquired by all pupils who used computers in all departments in one form or another prior to using computers for information retrieval**. The study found however that the majority, namely 25 (62%) out of 40 pupils who received training found it inadequate. The study also found that there was inadequate training because 12 (48%) out of 25 pupils indicated that the training lasted for only a few hours. Eight (32%) responded that their teachers were not good at computers while five (20%) indicated that there was no opportunity to practise, due to the limited number of computers that were available.

This study also established that training on the use of computers for information retrieval was provided specifically for the Water Audit projects. During this training, **computer Information retrieval skills which were not part of the earlier training in individual schools was included.** A majority 45 (75%) out of the 60 pupils explained that the training was not adequate. Their explanations were that the

training lasted for only one day and there was no follow-up from their teachers. The study also found that the majority 25 (76%) out of 33 pupils that used computers for retrieving information during the projects did not have sufficient time to use the computers. The main reasons for insufficient time were: 10 (40%) pupils could not use the computers themselves; eight (32%) experienced lack of access to computers as there was a limited number. Six (24%) had problems with the Internet and one (4%) experienced irregular access to the computers. The conclusion, therefore, was that the majority of pupils in the study did not receive adequate training in computer skills, and this shortcoming hampered their full participation in the projects.

The importance of adequate training has been emphasised by a number of researchers such as Beck (1982), Davidson (1985), Welch *et al.* (1996) and Kafai and Bates (1997). These researchers have stressed training for both pupils and teachers in the use of computers for information retrieval as critical to a good search and a successful project. In a research project reported by Beck (1982), as many teaching staff and pupils as possible were extensively trained on the microcomputer and the database used for the project. Davidson (1985:211-213) stated that several lessons were attended by pupils and teachers on the information skills programme, as outlined in Section 3.6 of the literature review of this thesis. She noted that the information retrieval process took less time in comparison with the time spent in helping pupils arrive at the stage where the concept of keywords retrieval was grasped. Welch *et al.* (1996:12) found, with regards to using the Internet, that the greatest problem (and the one verified in the present study) was the need for the training of teachers and pupils in schools. In a study by Kafai and Bates (1997), the pupils' involvement in the design and construction of the Web page was seen as a powerful way for the children to gain better understanding of existing Websites or Web directories. Library and Information Science (LIS) graduate interns who were in charge of the projects in each class undertook a number of intensive training sessions solely for the projects. Johnson and Eisenberg (1996:13) noted that imparting computer literacy to pupils should not be of the laundry list approach such as knowing the parts of the computer, writing reports with it, or searching for

information using a CD-ROM database. It must address the "how" of the computer use, the "when" and "why" skills and how these skills fit together to address student problems and complete their tasks. Rodda (1998:2), investigating an International Development Research Centre (IDRC) rural school e-mail communication project, found that encouragement, technical support and training were possibly the most critical needs for rural schools to be able to become part of the global village.

The present researcher, having been at the two training workshops that preceded the 1997 Water Audit projects, understood the impact of these training sessions during his rounds of administering questionnaires. Schools in the Natal Midlands, for example, were eager to use computers for information retrieval and communication of project findings. The Pietermaritzburg schools, on the other hand, were not so intent on the central issue of using computers, not through any fault of the teachers or pupils, but because the use of computers for information retrieval was only mentioned during the training session and not emphasised. Training in computer information retrieval at Umgeni Valley by the KwaZulu-Natal Nature Conservation Service and Share-Net (which did not take place during the Pietermaritzburg training session) could be regarded as the motivator for computer information retrieval by schools in the Natal Midlands area.

It is evident from the present study that sufficient time and effort had not been paid to the training of pupils for computer information retrieval. Pupils experienced problems in retrieving information from computers during the projects, and these problems are discussed in the following section.

6.6 Problems that hampered the use of microcomputers as information retrieval sources

One objective was to determine problems that hampered the use of the microcomputer as an information retrieval source during the Water Audit projects.

The present study found that **congestion,** from the point of view of teachers, either caused by a limited number of computers or floor space, was a hindrance to using computers for information retrieval during the Water Audit projects. Kafai and Bates (1997), reporting on the SNAP Dragon project, found that although having a large number of computers was an advantage to students, where the number of students per computer was high, support from the teacher during searches helped pupils retrieve needed information. In the case of the present study, however, support from teachers was lacking.

Lack of computer skills, as opposed to computer information skills, was identified by this study as a major hindrance to the effective use of computers during the Water Audit projects. This is in spite of computer skills having been identified as not the most important and difficult skills, as reported by Large; Beheshti; Breuleux, and Renuad (1994), Nahl and Harada (1996), and Herrings (1996), to be attained in the use of computers for information retrieval. Johnson and Eisenberg (1996:14) agreed that computer skills support and enhance students' information problem-solving abilities, but argue that they do not supplant the more general information skills. Notwithstanding, studies have identified computer skills as not difficult to attain, but important. Nahl and Harada (1996) found that students who reported that they were more experienced in the use of computers performed significantly better in the search process while students who reported less experience with computers had significantly lower confidence. They therefore recommended the need for instilling confidence in pupils through training in computers. Kafai and Bates (1997) also concluded that there was the need for mastering keyboard skills before information could be retrieved effectively from the Internet. They found that students with prior Internet experience tended to dominate the computer interaction, and students with more experience with computers and the Internet became the teachers of search teams, as they had earlier mastered the process.

With regards to the Water Audit projects **the ex-NED** schools were advantaged in terms of **computer skills** as stated by Mossom (1986). This is evidenced from the number of years such schools have been using computers for information retrieval

(Table 8). Conversely, **computer literacy had yet to be introduced into the previously DET schools because of the lack of computers in such schools**. Initiatives such as those of the World Bank and the International Development Research Council (IDRC) and SchoolsNET SA projects were timely in the use of computers in the disadvantaged schools. Carrol (1998:1), for example, reported that SchoolsNET had embarked on linking especially the previously disadvantaged schools to the Internet, and one of its priorities was the development and training of teachers in the use of computers.

It was found in the present study that another problem was the **lack of technical knowledge of computers by teachers.** Nonfunctional computers aggravated this problem. Teachers at the ex-DET schools also suggested that technical computer training for teachers should be a priority. Mossom (1986) Herring (1987) and Kafai and Bates (1997) alluded to the fact that the lack of technical computer knowledge could be a major factor and an embarrassment to teachers in cases where pupils tended to be more technically skilled than their teachers. To address this problem, Campbell (1996:14) advised that teachers and teacher-librarians needed to be effective and informed users of computers, in order to influence the information outcomes of their students. Nahl and Harada (1996) also held the view that teacher librarians should master the technology and have a higher and more comfortable level of expertise with computers and their use than most other teachers in the school.

The present study found that in the course of using computers for information retrieval, the majority 22 (66%) out of 35 responses indicated that **their problems were information skills related** in contrast to computer skills, specifically. This is confirmed by Beswick (1989), Large; Beheshti; Breuleux and Renuad, (1994), Johnson (1995), Nahl and Harada (1996) and Herring (1996). It was also confirmed in the computer information retrieval projects, namely, those of Beck (1982), Davidson (1985) and Kafai and Bates (1997) reviewed in the present study. Nahl and Harada (1996:199) pointed out that the critical conclusion in many studies was that the mechanics of computer searching are not the major stumbling blocks in

effective information retrieval by pupils. However, concept and term identification and confusion in understanding Boolean operators were definite hurdles.

Just as computers and computer literacy have been available in the ex-NED schools since 1986 (Mossom 1986) so have libraries and information skills. According to Kistan (1991:89), the policy that had driven the ex-NED to instill the skill of retrieval and use of information in pupils was that:

> Every child should be given as many opportunities as possible to do independent research and evaluation, and it was vital that the child learns where and how to find information, and having collected the material finds out for himself how to arrange it in a logical order and to determine for himself the relevance and or validity of the assembled statements.

There was no doubt that a vast majority of the ex-NED schools had provided resources to meet this policy in terms of print. Some of the ex-NED schools had developed their own Websites to meet the purpose of providing electronic information in today's information age. This situation is different in the ex-HOD schools, where Kistan (1991) recounted that there were no explicit guidelines for information skills in the curriculum. In the ex-DET schools, he noted that a media policy outlined in 1990 could not be effected due to the lack of resource materials. Johnson (1995:10) argued that teaching the effective use of information across the curriculum in most schools was more difficult and less likely than locating data. It is therefore evident from this study that with regards to information skills, a *sine qua non* to the process of information retrieval and information use, the ex-NED and the independent schools had a comparative advantage. The ex-DET schools are yet to benefit from basic facilities such as school libraries and media teachers: the means through which these skills could be achieved. The issue of information illiteracy is emphasised by Radebe's (1994:43) observation that in almost all tertiary institutions the most noticeable concern in students' inadequacies in terms of preparedness was information literacy, which was along racial lines due to schools being devoid of facilities and adequately trained personnel.

6.7 The role of the teacher-librarian in schools' computer projects

This did not form part of the issues investigated during the Water Audit projects, because teacher-librarians did not form part of the projects in the schools, and many previously disadvantaged schools did not have media teachers. It is, however, considered important and thus one that necessitated some discussion (see Beswick 1989; Large; Beheshti; Breuleux; and Renuad (1994); Todd 1997 and in the projects described in the literature review of this study). Beswick (1989:7) for example, suggested that the enormity of information and the problem of pupils finding their way through the glut of information required the need of a mediator in the form of the school librarian. This was echoed by Johnson (1995) and Large; Beheshti; Breuleux; and Renuad (1994:500). They stated that for pupils to be able to formulate the right search terms and relate this to the computer, they required the services of the school librarian. Todd (1997:12) believed that teacher-librarians could play key roles in the sound understanding of computers and information technology centring on developing students' knowledge and skills to manage, process, and utilise the enormous variety, quantity and other formats of information that IT provides.

With regards to the Bridge of Don Academy project, reported by Davidson (1985) and discussed in the literature review (Section 3.6) of this study, the whole project was centred around the school librarian due to the information retrieval that was involved. A similar situation prevailed in an earlier study, reported by Beck (1982). Kafai and Bates (1997) noted the important role of the teacher librarian during the SNAP Dragon project. They indicated that the graduate interns who were skilled in LIS did not only supervise the projects in the various classes but acted as *de facto* media teachers. They also pointed out that the WWW searching was an obvious extension of the many other kinds of information searching that fall within the range of the library media specialists' expertise. Silva (1995:243) noted that librarians have been key resources in the introduction and success of Internet classroom activities,

and school librarians have been the resource persons offering advice, instruction, and even technical support to teachers, since the library is the Internet access point for many students and teachers. Silva (1995:250) catalogued a number of reasons to support his view. These include: school librarians being comfortable with a wide array of computer and telecommunication equipment, the fact that they have been carrying out online searching using computers and in many cases have been teachers in small schools where they were better placed to help pupils acquire and develop superior information-processing skills.

The present researcher observed during questionnaire distribution and collection that the involvement of the school librarian in schools that had a school librarian during the Water Audit projects was minimal. This might be one of the reasons why pupils lacked information skills and hence experienced information retrieval problems. It was not surprising that some of the pupils indicated that the school librarian did not seem interested in what they were doing while they struggled with information retrieval for their projects.

6.8 Summary

This chapter discussed the results of the study which were based on objectives set in Chapter One. It considered firstly the availability of microcomputers as information retrieval sources during the Water Audit projects and then the extent of use of microcomputers *vis a vis* hard copy sources for the projects. It discussed the usefulness of microcomputers vis a vis hard copy sources and the extent of pupils training to enable them to retrieve and use information for the projects. Problems that were encountered during the projects were discussed and the role of the teacher-librarian was considered in view of its extensive coverage in the literature and computer information retrieval projects that were reviewed.

Chapter Seven
Conclusions and Recommendations

7.1 Introduction

This chapter presents a brief overview, the conclusions reached, and recommendations made from the findings of the study. Recommendations are also made for further research study into crucial areas not covered by the study.

7.2 An overview of the aim, objectives, purpose and a summary of the study

The aim of this study was to investigate the role of microcomputers as information retrieval tools in the greater Pietermaritzburg schools' 1997 Water Audit projects. Objectives of the study were to provide information on the extent of availability of microcomputers in the schools that participated in the projects; the extent of use of microcomputers and how useful microcomputers were *vis a vis* hard copy sources; the extent of availability of skills to enable pupils to retrieve information from microcomputers and problems encountered in the use of microcomputers during the projects. An additional objective was to examine literature on issues relating to microcomputers and their use as information retrieval tools in education. The purpose of the study was to provide information on issues relating to the availability and use of microcomputers in schools as education in South Africa becomes part of the information age; create an awareness of the impact that microcomputers could make on school projects and thereby education; and make recommendations concerning the way forward.

7.2.1 Summary of the study

Chapter One was an overview of the study comprising the problem statement and the aim and objectives of the study. The importance of the study was pointed out, the terms that were used defined and limitations of the study described. Chapter Two provided a background to the study. Areas examined were the importance of environmental education, the National Water Conservation Campaign in South Africa, the National Water Conservation vision, *Vision 2020*, the National as well as the greater Pietermaritzburg Water Week programme, the development of the environmental information database *Enviro-Facts*, and the Microcomputer project embarked upon by the KNNCS, in conjunction with Share-Net (Umgeni Valley).

Chapter Three was a review of related literature on microcomputers as information retrieval tools for education. Emphasis was placed on databases and the Internet. It also examined the steps, techniques and other issues relating to information retrieval from microcomputers. The availability of microcomputers as information retrieval sources in South African schools was also examined.

Chapter Four provided a review of the methodology employed for the study. It examined descriptive survey as the method for the study, examined the means of data collection, research population, sampling, and analysis of responses to data collection. Chapter Five embodied data presentation and analysis based on objectives set for the study as outlined in Chapter One. Findings from questionnaires were presented and explained. Chapter Six covered discussion of the findings made. Finally, Chapter Seven presented recommendations made and conclusions reached regarding the study.

7.3 Conclusions

Several significant findings have been made from the literature and survey of 24 teachers/co-ordinators (representing 24 schools) and 110 pupils who participated in

the Water Audit projects. These findings were that microcomputers were indeed a means of enjoying learning, enhancing information retrieval, communicating project findings, and hence enhancing school projects. It was also found that the majority of pupils who used microcomputers during the Water Audit projects found it useful.

While almost all the previously advantaged ex-NED and the independent schools' Water Audit projects were class-based, very few of the previously disadvantaged schools were. Similarly, a majority of the previously advantaged ex-NED and independent schools had environmental education as part of the curriculum, while none of the previously disadvantaged ex-DET and ex-HOD schools had environmental education as part of the curriculum. If environmental education was not part of the curriculum, and the Water Audit projects which involved the use of computers was not class-based, the inference drawn is that the use of computers and acquiring of computer skills was not integrated in any meaningful way into the curriculum of the previously disadvantaged schools, as was recommended by Johnson and Eisenberg (1996:13). This also suggested a lack of the required pedagogy necessary for benefiting from the use of microcomputers, as indicated by Johnson (1995) and Karaliotas (1997).

This study also found that not only was there gross inequality in the provision of microcomputers between previously disadvantaged and advantaged schools but the inequality existed with other information sources such as school libraries and media teachers, infrastructure such as school buildings, and logistical problems in the form of telephone and electricity. The study consequently revealed that the conditions of inequity of microcomputers, infrastructure and logistical problems deprived many pupils, the majority of whom were previously disadvantaged, access to electronic information and to collaborative education or electronic sharing of project findings during the 1997 schools' Water Audit projects.

This study concludes from available literature such as Camp (1996a), Camp (1996b), MQueen (1996), Manuel (1996) and Msimang (1998), among others, that environmental education in South Africa in relation to water conservation was indeed

very important for ensuring provision of clean and affordable water for all, averting a potential water crisis as predicted by Camp (1997:2) and for conserving wetlands and water catchment areas. The success story of the Westville Primary School Water Audit project, reported by Manuel (1996:3) was a case in point. The importance of group learning systems as the best method for environmental education (which would enhance the process of providing clean and affordable water and also enhance water conservation) had been emphasised by Voordouw (1987). However group learning was not possible in the majority of schools and for the majority of pupils in South Africa (mainly the historically deprived), due to the inequitable provision of microcomputers, infrastructure and logistical problems. This study supports the argument of Vuliamy (1987:89), that the legacies of colonialism (coupled with apartheid in the case of South Africa) did not favour attempts at curriculum reform which would encourage group learning systems in developing countries.

Through this study it has become apparent that, though useful, the non-availability of microcomputers was not the limiting factor to education in the previously disadvantaged communities in the greater Pietermaritzburg area and for that matter, in South Africa, as revealed in both the literature (NEPI 1992; HCHE 1997; Radebe 1997; Bot 1997) and the results of the survey. Lack of adequate school buildings, lack of electricity, telephones, and libraries constitute major factors in such schools. A confirmation of microcomputers not being a limiting factor to information retrieval was that, in the previously advantaged schools where microcomputers existed, the majority of the pupils used hard copy sources, and the majority found hard copy sources useful. Though one may argue that hard copy sources have traditionally been the sources of information retrieval, available literature confirms that computers are used as a complement to hard copy sources in school libraries (which do not exist in many schools in South Africa). The present study therefore showed that microcomputers are not, after all replacing books as was suggested by Lancaster (1977), Irving (1988), Kurzweil (1992), Welch *et al.* (1996) and Carvin (1998). This study concludes that in South Africa microcomputers are not used extensively for information retrieval in education, as there is a great backlog of

library provision in many schools as indicated by Bot (1997) in Table 1 and supported by the SAIDE Report (1998) in the literature review.

This study has shown that where microcomputers existed, there was the need for adequate training of both teachers and pupils (Beck 1982; Davidson 1985; Welch *et al.* 1996; Todd 1997; and Kafai and Bates 1997) to provide the required skills and hence the confidence to enable pupils to retrieve and use the resource for projects. The absence of effective training of both pupils and teachers in this study resulted in not only a limited number of pupils using the microcomputer, but teachers not being able to solve problems posed by the microcomputer in the course of its use, resulting in some pupils losing confidence in the projects, as indicated in Table 12.

Low levels of computer and information skills of both teachers and pupils (as indicated in the results of the survey given in Tables 14 and 25) also point to the need for extensive training that would have underpinned the use of microcomputers during the Water Audit projects and for any future project involving the use of the computer.

It can be concluded from this study that the success of school projects depended upon the total involvement of all role players, both inside and outside the school, from the initial planning stage. This was evidenced in all projects reviewed in the study (Beck 1982; Davidson 1985; and Kafai and Bates 1997). The Water Audit projects were not successful in many schools because of the top-down approach, as reported by the Midlands project co-ordinator, and schools indicated that some of their problems were lack of communication with project co-ordinators.

The loan of computers to schools by the KwaZulu-Natal Nature Conservation Service, while laudable, made little impact on the inequitable distribution and use of the microcomputer as an information and communication resource.

This study also concludes that the role of the media teacher as an information provider in schools microcomputer projects cannot be ignored. As pointed out in the

literature (Beck 1982; Davidson 1985; Welch *et al.* 1996; Todd 1997; and Kafai and Bates 1997), to mention a few, and emphasised in the research projects reviewed, the media teacher is indispensable in the planning and organisation of such projects. It is the present researcher's contention that the non-involvement of media teachers in the Water Audit projects contributed largely to the very low impact that microcomputers had on the Water Audit projects.

7.4 Recommendations

7.4.1 The role of Government

The role of the Deputy President (Mbeki 1996) and the Minister of Communication, Jay Naidoo, on issues relating to the use of information technology in education bodes well for South African education. Due to the history of inequitable distribution of educational resources (NEPI 1992 and Radebe 1997) and verified in the present study, there is a need for a concerted and co-ordinated effort from the central government to initiate policy to address such inequity and to provide school resources such as school buildings, media centres, electricity, telephones and, importantly, security, as well as microcomputers. As indicated by Silva (1995:244), the interconnection of all sectors of society in the United States of America to the Internet, including public schools, was legislated. A policy initiative is supported by the National Policy Framework for School Library Standards (NPFSLS) (SA Department of Education 1997:55). It advocates bringing on board all role players such as school governing councils, teachers, businesses, academia, government, non-governmental organizations, information workers and international organizations, to actively participate in addressing the issue of provision of information resources in schools. The policies will then need to crystallise into legislation which would mandate discharging of specific responsibilities to sustain gains made by the policy initiatives. The role of central government is of utmost importance. As pointed out by Silva (1995:245), provincial initiatives in Canada were not able to address the issues of inequity resulting in backlogs.

7.4.2 The role of non-governmental organizations (NGOs)

In view of the grave state of inequitable provision of computers in the majority of schools in South Africa, and the important role of computers as indicated in the literature by Clyde (1995), Mbeki (1996), Todd (1997), and Carvin (1998), initiatives of non-governmental organisations such as SchoolsNET SA, the World Bank and the IDRC, are in the right direction and must be supported and encouraged provincially, nationally and internationally. The issue of encouraging donor funding is supported by the National Policy Framework for school Library Standards (NPFSLS) (SA Department of Education 1997:68) which suggested that donor funding must be encouraged by provincial governments. NGO initiatives could be guided by suggested steps to further the development of Internet in schools (Calvin 1998:1). For example NGOs could draw on community networks and free-Nets to offer Web access at reasonable rates in rural and deprived urban communities. It is noted that pupils' inability to pay for Internet searches affected the *Water Indaba*, Internet, project at Sibongumbomvu community school (Chapter Two of this study). NGOs could also encourage schools with access and experience to offer assistance in demonstrating to others what the Web could do and its simplicity (Calvin 1998:1). NGO pilot projects could through research, serve as a means of determining issues for consideration, problem areas and also help determine policy options.

It is recommended that external agencies such as the Global Rivers Environmental Education Network (GREEN) and IDRC provide backing to initiatives such as the greater Pietermaritzburg schools' Water Audit projects. This is because initiating organizations like the KwaZulu-Natal Nature Conservation Service, Umgeni Water and Share-Net lack capacity in terms of personnel and finance to carry their mission and vision to a successful end. In this regard, it is strongly recommended that a computer laboratory be built through fundraising drives involving business, parents and NGOs at a central school at Mpophomeni. This is because the town is

nucleated[32] such that all six previously disadvantaged schools could conveniently share a common resource such as a computer laboratory. A continuation of the projects would keep the enthusiasm observed in the previously disadvantaged schools from waning beyond redemption and help them learn from their counterpart privileged schools' projects.

7.4.3 Private sector support

The private sector was called upon by the government of the United States of America to support the connection of schools, classrooms and media centres to the Internet (Silva 1995:244).Through SchoolsNet SA, the private sector in South Africa is being encouraged, on NetDay[33], to contribute new or used computers to historically deprived schools. Private sector initiatives are also recommended by the NPFSLS (SA Department of Education 1997:68), which recommends that such partnerships are necessary as a mechanism to supplement limited departmental funding. The policy framework document recommends tax rebate incentives as a means of encouraging such partnerships. Carroll (1998:1) reported that due to lack of funding to advance the objectives of SchoolsNET SA by provincial education departments, private organisations are being called upon to assist with donations of equipment.

7.4.4 School initiatives

It is recommended that since computers have high initial and maintenance cost, schools may have to share costs. Those that lack microcomputers should form information and communication technology (ICT) committees, as proposed by SchoolsNET SA and the SAIDE Report (1998:35). The ICT committee should be made up of school governing councils and teachers. Such committees should determine the need for computers in schools, discuss such needs and logistics with

---

[32]A central school is a walking distance from the six other schools in the community.

[33]The URL (Internet address) of SchoolsNET (http://WWW.school.za)

staff and parents, sensitise parents and organisations to their need, acquire funding or donations of microcomputer systems from NGOs such as IDRC or SchoolsNet SA, and plan, install and manage ICT projects from humble beginnings across the curriculum.

It is also recommended that school initiatives must be led by a self-motivated and dedicated teacher. As indicated by the midlands Water Audit project co-ordinator, the success of the Internet project at the Sibongumbonvu community school was due to the motivation of the school project co-ordinator.

7.4.5 Training of educators

It is recommended that refresher courses in computer skills and training workshops be organised for media teachers from schools where they exist, to equip and instill in them the confidence of taking up the challenges that the information age has to offer in schools. Media teachers must also take steps to integrate computer and information skills into the curricula of their schools. Though the present study found that computers are not the limiting factor to education in South Africa and are not replacing books, the NPFSLS (SA Department of Education 1997:34) has acknowledged the widening gulf in resources to include microcomputers. Educators and media teachers could not be oblivious to the prediction of Welch *et al.* (1996:12) that microcomputers may be the information resource and communication medium for schools in the future, and schools must take steps to equip educators accordingly (Todd 1997:12).

There was also the need to change the way teachers/librarians are educated so that the use of information technology resources are fully integrated into the initial training and certification process. The United States advisory council on the national information infrastructure has recognised this need, which is supported by the SAIDE Report (1998:36). The implication of this is that teachers would be exposed to the use of these technologies in an educational environment and acquire skills which they could in turn transfer to their pupils.

In view of the envisaged change in the South African schools' curriculum, as indicated by Musker (1997) and the NPFSLS (SA Department of Education 1997), to an outcome based education (OBE) which emphasises the use of information resources, including computers, it is recommended that further national audit of information resources, as conducted by Bot (1997) and Marquard (1998), be carried out. These updated information sources will provide government, education departments and policy-makers with the information necessary to plan more carefully and accurately the minimum standards of provision of information resources, including computers, to schools across the country, as recommended by the NPFSLS (SA Department of Education 1997:70).

7.5 Recommendations for further studies

It is recommended that the success story (case studies) of the Water Audit projects be repeated, in schools where conditions of availability of microcomputers, computer skills, information skills and appropriate training opportunities exist. This case study will serve as a pointer to the participating schools, especially the previously disadvantaged ones. In this regard, it is also recommended that a national overview of the role of microcomputers in environmental education be conducted in other provinces for the provision of information on provincial dynamics.

It is recommended that, in view of the extensive literature coverage of the important role of media teachers in school computer projects in this study (Beck 1982; Davidson 1985; Neuman (1990), Neuman (1995), Welch *et al* 1996; Todd 1997; and Kafai and Bates 1997), such a role be investigated in schools in which media teachers existed during the Water Audit projects.

Finally, it is recommended that a study be conducted to determine the extent to which media teachers are being trained in institutions across South Africa to provide computer-related information for pupils' and teachers' curricular use in the information age. This is relevant in view of available literature (Beck 1982; Davidson 1985; Neuman (1990), Welch *et al* 1996; Todd 1997; and Kafai and Bates 1997),

which suggested that in the developed countries of the United States of America and Australia, media teachers provide backing to teachers and pupils in computerised information projects. The role of school library teachers providing computerised information for pupils' and teachers' use is also in agreement with Neuman's (1990:159) indication that a number of factors had conspired to place the school library media centre and its professional staff in the ideal position to meet the challenges posed by the implementation of new technologies in educational settings. He recalled that, in America, the Association for Educational Communications and Technology (AECT) and The American Association of School Librarians (AASL) played a prominent role in the development of the American Library Association's (ALA) Presidential Committee's Statement on Information literacy which addressed the importance of technology in an information age school. The SAIDE Report (1998:36) also recommends the need to integrate information technologies into the initial training and ongoing professional development of educators.

List of References

African National Congress. 1994. *Implementation plan for education and training: report of the Library and Information Services (LIS), task team*. Braamfontein: Centre for Education Policy Development.

Aitchison, J. 1998. Access to books and journal articles by post-graduate students on a course-work master's programme in information studies at the University of Natal, Pietermaritzburg. MIS Thesis, Pietermaritzburg, University of Natal.

Barclay, D. 1996. *Teaching Electronic Information Literacy: a how to do it manual.* New York: Neal-Schuman. ISBN 1-55570-186-8.

Beck, C. 1982. Information Technology in Action. *The school librarian*, 30 (4): 307-311.

Behrens, S. 1990. Literacy and the evolution towards information literacy: an exploratory study. *South African journal of information science*, 58 (4): 353-357.

Behrens, S. 1995. Lifelong learning in the new education and training system. *Mousaion*, 13 (1&2): 250-263.

Bennet, D. 1989. Evaluating environmental education in schools. UNESCO, UNEP International Environmental Education programme. EE series 12. Unpublished paper.

Beswick, N. 1988. The use of knowing interactive models of school library. *School Librarian*, 36 (1): 6-9.

Bless, C. and Higson-Smith, C. 1995. *Fundamentals of social research methods: an African perspective*. 2nd ed. Juta: Kenwyn. ISBN 0-7021-3432-5.

Borman, J. 1995. Computers huh? Computer skills as part of the curriculum. *Information technology review,* 2: 30-31.

Bot, M. 1997. School register of needs: a provincial comparison of school facilities 1996. *Edusource datanews,* 17: 1-4.

Briceno, S. and Pitt, D. eds. 1988. *New ideas in environmental education* .Croom Helm: London. ISBN 0-7099-5042-X.

Brosius, M. 1993. DECD and the climate change (DECD/IEA publication: response to the Rio Earth Summit; presented at the 1993 ALA Conference). *Documents to the people*, 21: 208-211.

Busha, C. and Harter, S. 1980. *Research methods in librarianship: techniques and interpretation*. New York: Academic Press. ISBN 0-12-147550-6.

Camp, S. 1996a. ed. *101 Ideas for National Water Week and River Day*. Cape Town: National Water Conservation Campaign. ISBN 0-062019790-0.

Camp, S. 1996b. ed. *On Stream: Promoting Water Awareness*. March 1996. Durban: Fishwicks.

Camp, S. 1997. ed. *A guide to water saving in South Africa: many ways you can save water, the environment, and a lot of money.* Cape Town: National Water Conservation Campaign.

Campbell, L. 1996. Students or teachers? Who should our targets be? *ACCESS*, 10 (4): 14-16.

Carroll, C. 1998. National network to link 28 000 schools. In *Computing SA*: *incorporating computer world*, 18 (41): 1-14.

Carvin, A. 1998. The World Wide Web in Education: A closer look. <http://edweb.gsn.org/web.intro.html> 15 October 1998.

Clyde, L. 1995. Computers in school libraries: the Internet and Australian schools. *ACCESS,* (9) 2: 26-28.

Compaan, D. 1990. Literacy promoted by Technology. *Educaction and Culture*, 1: 13-14.

Condon, R. 1997. Technology education gets seal of approval: IS Director emphasise people business skills. *Computing SA*, 17: 22 & 23.

Crane, B. And Markowitz, N. 1994. A model for teaching critical thinking through online searching. *Reference librarian*, 44: 41-52 .

Davidson, S. 1985. Computerised information retrieval in a school resource centre. *School librarian*, 33 (3): 210-213.

De Lange, I. 1996. GREEN. In: Camp S. ed. *On stream: promoting water awareness.* Durban: Fishwicks.

Dervin, B. 1977. Useful theory for Librarianship: "Communication not information" *Drexel library quarterly*, 13: 16-32.

Drost, A. 1998. Technology Education: a new learning area for South African Schools. *HSRC/RGN*, 5 (6): 21-23.

Eco, U. 1996. Why new media won't kill books. *World press review,* 3 & 4: 5.

Eisenberg, M. 1992. Current Research. *Schools library media quarterly*, 20: 103-109.

Eyitayo, S. 1996. Securing your system against virus attack: the experience of a medical library in Nigeria. *Information development*, 12: 215-217.

Flagg, G. 1997. Hacker, virus shut down libraries' online services. *American libraries*, 28 (1):16-17.

Freedman, A. 1996. *The computer desktop encyclopaedia*. New York: American Management Association. ISBN 0-8144-0012-4.

Gay, L. 1976. *Education Research: competencies for analysis and application.* Columbus, Ohio: Merrill.

Gittner, A. 1996. Using the Internet in schools. Some general thoughts and implications. <http://edweb.cacamcnty.gov.ukhinchin Brooke/HOMEPAGE/USING.HTM>. 19 December 1996.

Govender, G. 1990. The application of microcomputer technology for information retrieval in library resource centres of Indian secondary schools in South Africa. Ph.D. Thesis. Department of Information Studies, University of Natal, Pietermaritzburg.

Gower, M. 1992. An investigation into the Distribution and use of *Enviro-Facts*. Masters Thesis. Department of Geography, University of Natal, Durban.

Gwyneth, T. Poulter, A. and Hiom, D. 1996. *The library and information professionals guide to the Internet*. London: Library Association. ISBN 1-85604-151-4.

Harter, S. 1986. *Online information retrieval: concepts, principles, and techniques.* San Diego, Academic Press. ISBN 0-12-328456.

Haricombe, L. 1992. The effects of an academic boycott on academics in South Africa. Ph.D. Thesis. Department of Information Science: University of Illinois, Urban-Champaign.

Herring, J. 1987. ed: *The microcomputer: the school librarian; and the teacher: An introduction with case studies*. London: Clive Bingle. ISBN 0-85157-399-1.

Herring, J. 1996. *Teaching Information Skills in schools*. London: Library Association. ISBN 1-85604-176-X.

Holmberg, J. and Timberlake, L. 1993. Facing the future: beyond the earth summit. London: Earthscan. ISBN 1-85383-154-9.

Holtman, B. 1996. 2020 vision of Work in South Africa Youth Project. In Camp S. ed. *On Stream: Promoting Water Awareness*. Durban: Fishwicks.

Horton, W. and Ilcheva S. 1995. A university on the World Wide Web: a case study of the University of Natal, South Africa. *African journal of library archives & information science* 5 (2): 99-108.

Irving, A.1988. School libraries fifty years ahead: are you ready yet? *School librarian* 36 (1): 10-13.

Isaacman, J. 1996. *Understanding the National Qualifications Framework: a guide to life-long learning.* Johannesburg: Heinemann.

Jackman, K. 1998. Warning: Children are at risk: hi-tech health jinx for Kids. *Sunday Tribune*: January 25 pg. 3.

Jackson, M. 1994. Library information skills and standardised achievement tests. In: Kuhlthau, C. ed. Assessment and the school library media centre. Englewood: Libraries Unlimited.

Johnson, D. 1995. Student access to the Internet. *Emergency librarian*, 22 (3): 8-12.

Johnson, D. and Eisenberg, M. 1996. Computer literacy and information literacy: A natural combination. *Emergency librarian,* 23: 12-16.

Kafai, Y. and Bates, J. 1997. Internet Web-searching instruction in the elementary classroom: Building a foundation for information literacy. *School library Media Quarterly,* 25 (2): 103-111.

Karaliotas, Y. 1997. Project Report. Learning on and over the Internet: dynamics and limitations: will the new technology become the main vehicle for a learning society? <Http://www.users otenet.gr/~kar1125/education.htm> 12 November 1997.

Kistan, G. 1991. Perceptions and utilisations of media centres in South Africa. Ph.D. Thesis. Department of Information Studies, University of Natal, Pietermaritzburg.

Kuhlthau, C. 1994. ed: *Assessment and the school library media centre*. Englewood: Libraries Unlimited.

Kurzweil, R. 1992. The futurecast: The future of libraries Part 1: the technology of the book. *Library Journal*, 117 (1): 80-82.

Lancaster, F. 1977. The dissemination of scientific and technical information: towards a paperless system, 11-25. University of Illinois graduate school of library science, University of Illinois.

Large, A.; Beheshti, J.; Breuleux and Renaud, A. 1994. A comparison of information retrieval from print and CD-ROM versions of an encyclopaedia by elementary school students. *information processing and management*, 30 (4): 499-513.

Leach, A. 1991. The reading interests of newly literate urban black adults. MIS Thesis. Department of Information Studies, University of Natal, Pietermaritzburg.

Leady, P. 1993. *Practical research: planning and design*. 5th ed. New York: Macmillan. ISBN 0-02369242-1.

Leady, P. 1997. *Practical research planning and design* 6th ed. Columbus: Princeton Hall. ISBN 0-13-241407-4.

Manuel, T. 1996. Water auditing at schools and homes of school pupils could mean huge savings for local schools and communities. In: Camp, S. Ed. *On stream: promoting water awareness*. Durban: Fishwicks.

Manuel, T. 1997. *Teachers' hand book, water audit. How your school can be water wise*. Johannesburg: Jacana Education. ISBN 1-874955-82-4.

Marquard, S. 1996. Survey of schools connected to the Network. <Http://www. school.za/research/sm98a-broadcast.htm> 13 August 1998.

Masuku, L. 1996. *Water Indaba* on the Web. In: . Camp S. ed. *On Stream: Promoting Water Awareness*. Durban: Fishwicks.

Mbeki, T. 1996. The information community and the developing world. Unpublished paper on the need for developing an information community in South Africa .

Mchunu, H. 1998. Water waste costing millions. In *The Natal Witness*, July 3. Pg. 1.

McQueen, C. 1996. The user pay repayment project. In: Camp, S. ed. *On stream: promoting water awareness*. Durban: Fishwicks.

Morgan, Kim. 1995. Using the Internet: the experiences of an amateur. *ACCESS,* 9 (3): 14-15.

Mossom, M. 1986. Status of computer education in Natal schools. University Lecture, delivered at the University of Natal, Pietermaritzburg, on the 1st of October 1986.

Msimang, T. 1998. Business to pay for rural water. In: *The Echo*, July 16. Pg. 1.

Musker, P. 1997. OBE Theory into practice: an introductory guide. Braamfontein: Nolwazi. ISBN 1919762620.

Nahl, D. and Harada V. 1996. Composing Boolean search statements: Self-confidence, concept analysis, search logic and errors. *School library Media Quarterly*, 24 (4): 199-207.

NCHE see South African National Commission on Higher education.

NPFSLS see South African Department of Education.

National Educational Policy Investigation 1992a. *National Educational Policy Investigation*; *Library Services Report*. Cape Town: Oxford University Press.

National Educational Policy Investigation 1992b. *National Education Policy Investigation; Governance and administration.* Cape Town. Oxford University Press.

NEPI see National Education Policy Investigation a.

NEPIb see National Education Policy investigation a.

Neuman, D. 1990. Beyond the chip: a model for fostering equity. *School library media quarterly*, 18 (3): 158-164.

Neuman, D.1993. Designing databases as tools for higher-level learning: insights from instructional systems design. *Educational technology research and development*, 41 (4):25-46.

Neuman, D. 1995. High school students' use of databases: results of a Delphi study. *Journal of the American Society for Information Science,* 46: 284-298.

Neuman, D. 1997. Learning in a digital Library. *Library trends*, 45 (4): 687-707.

Nevell, R. 1993. Questionnaire. In: Gilbert, N. ed. *Researching in social life* London, Sage. pg 94-115.

O'Donoghue, R. 1998. Personal communication. Pietermaritzburg: 12 April.

Olën, S. 1989. Computers and information retrieval in school media centres. *Mousaion* Series 3, 7 (2): 44-57.

Our Earth-our future-1992. A Yorkshire peoples' declaration - "Earth Summit". Forum Report- United Nations Association (UK) forum report. Yorkshire Region.

Pirkola, A. and Jarvelin, K. 1996. The effect of anaphor and ellipsis resolution on proximity searching in a text database. *Information processing and management*. 32: 199-216.

Powell, R. 1991. *Basic research methods for librarians*. 2nd ed. Norwood: Ablex. ISBN 0-89391-688-9.

Prytherch, R. 1995. *HARROD'S Librarians' glossary: 8th ed. 9000 terms used in Information Management, Library Science, publishing, the book trades, and archive management.* Aldershot: Gower. ISBN 0-56607-533-4.

Radebe, T. 1994. Training school Librarians in South Africa: a personal view. *Innovation*, 9: 43-47.

Radebe, T. 1997. Experiences of teacher librarians in the workplace after completion of the school librarianship programme. *South African Journal of library and information science,* 65 (4): 218-226.

Rodda, Y. 1998. Final report on a pilot project into the use of Cell-Data for connectivity to two rural schools in South Africa. <Http://www.idrc.org.za/connectsa/res_results /twocells.htm> 21 August 1998.

Samancors, 1996. Samancors, sponsors computer school. *Information technology review*, 3 (2): 55-56.

SAIDE Report see South African Institute for Distant Eeducation.

Saunders, W. and Pinhey, T.1983. *The conduct of social research.* New York: Holt, Rinehart and Winston. ISBN 0-03-058953-3.

Schlessinger, J. and Karp, R. 1990. Availability and use of microcomputers in public schools. Results of three earlier studies and interpretation of data. *Microcomputers for information management,* 7: 41-50.

Seaman, C. 1987. *Research methods: principles, practice and theory for nursing.* 3rd. ed. Norwalk, Connecticut: Appleton and Lange. ISBN 0-8385-8275-3.

Shoolbred, M. 1990. In our opinion... IT and the school Librarian. *The school librarian*, 38: 44-45.

Shreuder, D. 1996. A green consortium in South Africa. In: Camp, S. ed. *On Stream: Promoting Water Awareness.* Durban, Fishwicks.

Simeone, P. 1996. The challenges of the Internet across curriculum. *ACCESS*, 10 (4): 27-29.

Silva, M. 1995. The process of introducing Internet-based classroom projects and the role of the school librarians. *Education for information,*13: 243-252.

South African Department of Education 1997. National Policy Framework for School Library Standards: *A discussion document prepared by the Centre for Educational Technology and Distance Education*. Pretoria: Centre for Educational Technology and Distance Education.

South African Institute of Distance Education Report: Exploring the use of Internet and Satellite Technologies to support the professional development of educators: Developing appropriate learning and teaching models. <Http:/www.saide.org.za/multi/m-r-report.hml>
12 June 1998.

South African National Commission on Higher education 1996. *National Commission on higher Education report: a framework for transformation* S.l :sn. (RP 124/1996).

Sprainger, N. 1997: Evaluating multimedia resources: strategies for selection and supporting information skill development. *ACCESS*, 11 (2): 27-29.

Taylor, J. 1997. Share-Net: a case study of environmental education resource material development in a risk society. Ph.D. Thesis. Department of Environmental Education, Grahamstown, Rhodes University.

Tenopir, C. 1995. Online databases: ASCII full texts. *Library Journal*, 120: 34-37.

Thorpe, P. 1984. The impact of new information technology in developing countries. *Journal of information science*, 8: 213-220.

Todd, R. 1997. IT and learning a never-ending beginning. *ACCESS*, 11 (1):11-14.

Vulliamy. 1987. Environmental Education in Third World Countries. In: Briceno, S. and Pitt, D. eds. *New Ideas in Environmental Education*. London:Croom Helm ISBN 0-7099-5042-X.

Voordouw, J. 1987. Open learning and team-working: a perspective from youth organisations. In: Briceno, S. and Pitt, D. eds. *New Ideas in Environmental Education*. London:Croom Helm ISBN 0-7099-5042-X.

Welch, B. *et al.* 1996. Victorian secondary school libraries Internet and beyond. *ACCESS,*10 (1):12-14.

Weinberger, M. 1997. Just in time learning with electric library. *Library trends*, 45 (4): 623-638.

Williams, D. 1987. Database creation: In: Herring, J. ed. *The microcomputer the school librarian and the teacher an introduction with case studies*. London: Clive Bingle ISBN 0-85157-399-1.

Woodcock, J. 1991. *Computer Dictionary: the comprehensive standards for business, school, library and home*. Washington: Microsoft ISBN 155615-231-0.

Wozny, L. 1982. Online bibliographic searching and student use of information: An innovative teaching approach. *School library media quarterly,* 11 (1):35-42.

Young, A. 1995. All aboard the gravy train. *Information technology review*, 2 (2): 64.

APPENDICES

Appendix 1 Teachers'/co-ordinators' letter of introduction of questionnaire

QUESTIONNAIRE

DEPARTMENT OF INFORMATION STUDIES UNIVERSITY OF NATAL
QUESTIONNAIRE ON THE ROLE OF COMPUTERS AS INFORMATION RETRIEVAL SOURCES IN SCHOOLS' WATER AUDIT PROJECTS

I am a Masters Student in the Department of Information Studies, University of Natal. I am pursuing a study on the role of computers as information retrieval sources in schools in the greater Pietermaritzburg area during the water quantity and water quality (Water Audit) projects. Your school has been suggested by the KwaZulu-Natal Nature Conservation Service and Umgeni Water as having participated keenly in the projects. I would be most grateful if you as the school project co-ordinator or class teacher would assist me by responding to the following questions in this questionnaire and returning it to me as soon as possible.

Please answer the questions as honestly as possible.

Your answers will be treated confidentially.

Please tick the boxes of your choice and fill in the spaces provided.

Thank you for your assistance

Hillar Addo

Appendix 2 Teachers'/co-ordinators' questionnaire

QUESTIONNAIRE ON THE ROLE OF COMPUTERS AS INFORMATION RETRIEVAL SOURCES IN SCHOOLS' WATER AUDIT PROJECTS

Please answer the questions as honestly as possible.

Your answers will be treated confidentially.

Please tick the boxes of your choice and fill in the spaces provided.

1. Name of school .....

2. Location: a) Pietermaritzburg ☐

   b) Natal Midlands ☐

3. Which of these information resources are present at your school? (*Please tick those that apply*)

   a) Computer Laboratory ☐

   b) School library with computers ☐

   c) School Library with no computers ☐

   d) School Librarian (Media Teacher) ☐

   e) None of the above ☐

4. Is environmental education part of the school curriculum?

   a) Yes ☐

   b) No ☐

5. If no, why not? . . . . . .

6. The water audit and water quality projects form part of:

   a) Class project ☐

   b) School club project ☐

   c) Other (*please specify*). . . . . .

7. If the answer to question 6 is a class project what class/grade was it?

   . . . . . .

8. Do you generally have computers available to pupils for information retrieval?

   a) Yes ☐

   b) No ☐

9. If yes, for how long have the computers been used for information retrieval?

   . . . . . .

   . . . . . .

10. If there are computers in your school, are they owned by the school?

    a) Yes ☐

    b) No ☐

11. If yes, go to Question 16.

    If no, why not? . . . . . .

    . . . . . .

12. Were computers made available to you on loan for the Water Audit projects?

a) Yes ☐

b) No ☐

13. If yes go to question 14

If no, why not? .....

.....

14. Did you have problems acquiring the computer system for the water audit and water quality projects?

a) Yes ☐

b) No ☐

15. If yes, what were the problems? .....

.....

16. How many computers were available in total to pupils during the water quality and water audit projects? .....

17. In your opinion, which source was used the most for information retrieval during the water audit and water quality projects.

a) computers ☐

b) hard copy (books, pamphlets, periodicals, etc) ☐

18. In your opinion why was one source used more than the other in question 17 above? .....

.....

19. How often were the following used as information sources during the water audit and water quality projects? (*Please tick the spaces that apply*)

	Very often	Often	Not often	Not at all
a) Enviro-Facts on Internet	.....	.....	.....	.....
b) Enviro-Facts on diskette	.....	.....	.....	.....
c) Enviro-Facts on pamphlets	.....	.....	.....	.....

20. Did the pupils experience problems in the course of using the computers during the water audit and water quality projects?

a) Yes ☐

b) No ☐

21. If yes, which problems were experienced? . . . . . .

. . . . . .

22. Were you able to solve these problems?

a) Yes ☐

b) No ☐

23. If no, why not? . . . . . .

. . . . . .

24. In your opinion did these problems affect the quality of the water audit and water quality projects?

a) Yes ☐

b) No ☐

25. If yes, how did they affect the projects? . . . . . .

26. In your opinion did the computer information resource positively contribute to the water audit and water quality projects?

a) Yes ☐

b) No ☐

Please elaborate . . . . . .

. . . . . .

27. Do you have any suggestions relating to the future use of computers for environmental education? Please list them: . . . . . .

. . . . . .

Thank you for answering the questions provided in this questionnaire.

Appendix 3 Pupils' letter of introduction of questionnaire

DEPARTMENT OF INFORMATION STUDIES UNIVERSITY OF NATAL QUESTIONNAIRE ON THE ROLE OF COMPUTERS AS INFORMATION RETRIEVAL SOURCES IN SCHOOLS' WATER AUDIT PROJECTS

I am a Masters student in the Department of Information Studies, University of Natal. I am pursuing a study on the role of micro-computers as information retrieval sources in schools in the greater Pietermaritzburg area during the water quantity and water quality (Water Audit) projects. Your school was suggested by the KwaZulu-Natal Nature Conservation Service and Umgeni Water as one of the schools that participated keenly in the projects. I would be most grateful if you as a pupil who participated in the projects would assist me by responding to this questionnaire and returning it to me as soon as possible.

Please answer the questions as honestly as possible

Your answers will be treated confidentially.

Please tick the boxes of your choice and fill in the spaces provided.

Thank you for your assistance.

Hillar Addo

Appendix 4 Pupils' questionnaire

QUESTIONNAIRE ON THE ROLE OF COMPUTERS AS INFORMATION RETRIEVAL SOURCES IN SCHOOLS' WATER AUDIT PROJECTS

Please answer the questions as honestly as possible

Your answers will be treated confidentially.

Please tick the boxes of your choice and fill in the spaces provided

1. Did you use computers for information retrieval during the water audit and water quality projects?

   a) Yes ☐

   b) No ☐

2. If no, why not? . . . . . .

3. If yes, between hard copy and computer sources which did you use more during the water audit and water quality projects?

   a) computers ☐

   b) hard copy (books, pamphlets, periodicals, etc.) ☐

4. Why did you use your choice in question 4 above more? . . . . . .

   . . . . . .

   . . . . . .

5. How often did you use the following information sources during the water audit and water quality projects? (*Please tick the spaces that apply*)

	Very often	Often	Not often	Not used
a) Enviro-Facts on Internet	.....	.....	.....	.....
b) Enviro-Facts on diskette	.....	.....	.....	.....
c) Enviro-Facts on pamphlets	.....	.....	.....	.....

6. Which of these did you find most useful during the water quality and water audit projects? (*Please tick the spaces that apply*)

	Very useful	Useful	Not useful	Not used
a) Enviro-Facts on Internet	.....	.....	.....	.....
b) Enviro-Facts on diskette	.....	.....	.....	.....
c) Envir-Facts on pamphlets	.....	.....	.....	.....

7. What type of training did you acquire prior to using a computer for information retrieval? (*Please tick what is/are applicable*)

a) Computer awareness ☐

b) Keyboard skills ☐

c) Information skills ☐

d) Computer information retrieval skills ☐

e) Other (*please specify*) .....

f) None ☐

8. If you did receive training, was it adequate to enable you to retrieve information from computers on your own?

a) Yes ☐

b) No ☐

9. If no, why not? . . . . . .

. . . . . .

10. What type of training did you acquire prior to the water audit and water quality projects? (Please tick what is/are applicable)

a) Computer awareness ☐

b) Keyboard skills ☐

c) Information skills ☐

d) Computer information retrieval skills ☐

e) Other (*please specify*) . . . . . .

f) None ☐

11. If you did receive training, was it adequate to enable you to retrieve information from computers on your own during the water audit and water quality projects?

a) Yes ☐

b) No ☐

12. If no, why not? . . . . . .

. . . . . .

13. Did you have sufficient time to use the computer as a source of information during the Water Audit projects?

a) Yes ☐

b) No ☐

14. If no, why not? . . . . . .

. . . . . .

15. Was someone present at the school to help with computer information retrieval problems during the water audit and water quality projects?

a) Yes ☐

b) No ☐

16. If no, why not?. . . . . .

. . . . . .

17. If yes, were you satisfied with the help?

a) Yes ☐

b) No ☐

18. If not, why not? . . . . . .

. . . . . .

19. Did you experience any other problems while using the computer as a source of information for the water audit and water quality projects?

a) Yes ☐

b) No ☐

20. If yes, please list the problems . . . . . .

. . . . . .

. . . . . .

21. If you had access to a computer during the Water Audit projects do you have any suggestions as to how the computer could help you better as an information source for environmental education?

a) Yes ☐

b) No ☐

22. If yes, please list them . . . . . .

. . . . . .

. . . . . .

Thank you for answering the questions provided in this questionnaire.

Appendix 5 List of schools presented by the Kwazulu-Natal Nature Conservation Service and Umgeni Water as schools that participated in the 1997 schools' Water Audit Projects. Number of pupils surveyed is enclosed in brackets attached to the various schools.

EX-NATAL EDUCATION DEPARTMENT

1. ATHLONE PRIMARY SCHOOL
2. MARIZTBURG COLLEGE HIGH SCHOOL
3. HOWICK PREPARATORY SCHOOL (8)
4. GIRLS' HIGH SCHOOL (7)
5. BRUNTVILLE SCHOOL
6. EPS SECONDARY SCHOOL
7. SCOTTSVILLE PRIMARY SCHOOL (6)
8. CLARENDON PRIMARY SCHOOL (4)
9. WESTON AGRICULTURAL COLLEGE
10. ALEXANDRA HIGH SCHOOL
11. GRANGE PRIMARY SCHOOL (4)
12. PELHAM SENIOR PRIMARY SCHOOL (12)

EX-DEPARTMENT OF EDUCATION AND TRAINING (DET) SCHOOLS

1. GEORGETOWN HIGH (3)
2. NHLANHLENI HIGHER PRIMARY SCHOOL (2)
3. EMNYEZANENI SENIOR PRIMARY (1)
4. MTHOMBO JUN. SEC. (2)
5. NOQGAZA(INJOLOBA) PRIMARY (1)
6. ASTHUTHUKE SCHOOL (1)
7. CEDARA FARM SCHOOL
8. SIBONGUMBOMVU COM. SCHOOL (5)
9. MPOPHOMENI HIGH SCHOOL (2)
10. ASIBEMUNYE HIGH SCHOOL (2)
11. ZAMUTHULE PRIMARY SCHOOL
12. INJOLOBA HIGH (3)
13. NOTTINGHAM ROAD SCHOOL (1)
14. HILTON FARM SCHOOL

EX-DEPARTMENT OF EDUCATION AND CULTURE (HOUSE OF DELEGATES)

1. NORTHBURY PARK SECONDARY (3)
2. HOWICK WEST SECONDARY SCHOOL (5)
3. HOWICK WEST PRIMARY

INDEPENDENT (PRIVATE) SCHOOLS

1. ST.JOHN'S DSG
2. LADDSWORTH PRIMARY (7)
3. ST.ANNE'S
4. COWAN HOUSE
5. THE WYKEHAM COLLEGIATE (8)
6. TREVERTON PREPARATORY SCHOOL (7)
7. ST. NICHOLAS SCHOOL
8. CLIFTON PREPARATORY SCHOOL
9. MICHAELHOUSE (8)
10. HILTON COLLEGE
11. TREVERTON HIGH SCHOOL (8)